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ECONOMIC GEOGRAPHY

OCTOBER

CLARK UNIVERSITY, WORCESTER, MASSACHUSETTS, U.S.A.

OUR CONTRIBUTORS

Mr. Matthews has been identified with the fishing industry for nearly thirty years, and is recognized as an authority on fishery matters. He is actively engaged in business as Production Manager for the Atlantic Coast Fisheries Company; President of the Shipbottom Pound Fishers, Inc.; and Secretary of the Portland Trawling Company. He edits the *Atco Fisheries News*, a monthly publication devoted to the commercial fisheries. He is Treasurer of the United States Fisheries Association. In collaboration with Mr. R. H. Fiedler, he made a survey of the fishing industry in New York City during 1925 for the U. S. Department of Commerce, Bureau of Fisheries.

Dr. White is professor of geography at Randolph-Macon Women's College. He is working on a series of articles on iron and steel manufacture, of which this is the second to be published.

Mr. Mitchell, who contributes an article entitled "America's Resources in Nitrogen, Potash and Phosphorus," has been connected with the United States Geological Survey since 1907, first serving in administrative capacity and then as private secretary to the Director.

Miss Venter, teacher of geography in the Jefferson Junior High School at Columbia, Missouri, received the Bachelor's degree at the University of Missouri. She is now working toward her Master's degree.

Dr. Ekblaw is professor of geography at Clark University and assistant editor of ECONOMIC GEOGRAPHY.

Dr. Baker, economic analyst with the U. S. Department of Agriculture, contributes Part VI of the series of articles on the "Agricultural Regions of North America." He has been in charge of the preparation of the *Atlas of American Agriculture*, and in 1923 was chairman of the Yearbook Committee of the Department of Agriculture. He is the author of several agricultural bulletins, and joint author, with Dr. V. C. Finch, of the "Geography of the World's Agriculture." His publications relative to agricultural resources and their utilization have appeared in the agricultural yearbooks, in the *Annals of the Association of American Geographers*, in the *Geographical Review*, and ECONOMIC GEOGRAPHY.

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THE FISHERIES

LIKE hunting, fishing was one of man's earliest activities. In seeking his food, the primitive man who had access to streams or pools or the shores of seas could always turn to them for a fairly certain supply when all else failed him. If finned fish were hard to get he could dig up a few clams or mussels, catch a turtle or two, or perhaps capture a lobster, a crab, or a cray fish. As he advanced toward civilization and made nets and boats he could seek farther and find a surer supply, but only with some hazard from storm and sea, some surrender of safety that the land insures. Even yet, the harvest of the sea lures whole nations out upon the waters, some even to the ends of the earth.

It is not solely for food that the fisheries have been so significant. The vicissitudes of the fisherman's life have skilled him in navigation, stimulated his courage, accustomed him to sea- and sky-bound horizons without a glimpse of land in sight, and steeled him to the hazard and hardship of long, adventurous explorations. The fisheries have been the nurseries of navies—for Greece, for Rome, for France, for Japan, for Britain. How have not the fisheries of the Euxine, the Mediterranean, the Bay of Biscay, the Dogger Bank, the Grand Banks affected the rise and fall of nations?

The value of the fisheries remain as great as ever. The seas are not inexhaustible in their wealth of food, but they seem to replenish their stores more quickly and more certainly than soils regain their fertility, forests restore their stands of lumber, or grasslands regain their cover. The fisheries will ever attract the shore-dwelling peoples, augment the land supplies of food, and train the seamen of the nations.

ECONOMIC GEOGRAPHY

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FISHERIES OF THE SOUTH ATLANTIC AND GULF STATES

J. H. Matthews

Production Manager, Atlantic Coast Fisheries Company

THE fisheries of the South Atlantic and Gulf differ as greatly from those of the North Atlantic as the agricultural products of the northern regions differ from the products of the South. The Gulf Stream, flowing through the Straits of Florida, follows the general contour of the coast until it reaches Cape Hatteras, where the waters of the Arctic Current, flowing in an opposite direction, are interposed between it and the coast. From about this point and northeastward the Arctic Current forms a cold wall of water covering the Continental Shelf upon which are the fishing grounds of the North Atlantic. South of Cape Hatteras, the influence of the Gulf Stream extends practically to the shore line, and it is in this warmer water that lie the fishing grounds of the South Atlantic.

North Carolina occupies a unique position regarding the coastal fisheries, as its most easterly point, Cape Hatteras, is the southern limit for several species of fish common in the more northerly waters, such as the cod, tautog, and mackerel; and it is also the northern limit for many species characteristic of the waters of Florida and the West Indies. North Carolina has the most remarkable coastal section of any state bordering the Atlantic seaboard. The peculiar character of this region has a great influence on the variety and abundance of the fish life and has favored the development of most extensive fisheries. The outer shore, in the northern and central portions of the state, is simply a bar of sand separating the waters of the ocean from those of an enormous inland sound system. The sounds communicate with the ocean either directly through narrow inlets or through other sounds; and many receive the drainage of important streams. The sounds in geographic order are Currituck, Albemarle, Roanoke, Croatan, Pamlico, Core, Bogue, Stump, Topsail, Middle, Masonboro, and Myrtle, and they constitute a series such as exists in no other state.

Albemarle Sound is said to be the largest coastal body of fresh water in the world. Its extreme length from east to west is 60 miles, and its maximum breadth is 15 miles, the average being about 7 miles; its area is about 450 square miles. The water is normally quite fresh, but in dry weather it becomes brackish or salt, especially at its eastern end. The Sound, with its tributaries, is an exceedingly important spawning ground for shad, alewives, striped bass, and other migratory fishes, and also contains many other valuable species. Its fishery resources exceed those of any of the other sounds, and this fact, together with the facility with which all kinds of nets may be set and operated, makes its fisheries of great importance.

Pamlico Sound is an imposing body of water, and, next to Long Island, is

the largest sound on the Atlantic Coast of the United States. Its length is 75 miles, and its width is from 10 to 30 miles, the area being about 1,860 square miles. The general depth is 15 to 20 feet. The waters of Currituck, Albemarle, Croatan, and Roanoke Sounds discharge into it, and on the south, Core Sound communicates with it. The long narrow strip of desolate sand with hogfish. The anadromous fishes, on their way to Albemarle Sound, for the most part pass through New Inlet and to a less extent through Oregon and Hatteras Inlets; while most of the fishes bound for the Neuse and Pamlico Rivers come from the ocean through Ocracoke and Hatteras Inlets.

Core Sound begins at the extreme southern part of Pamlico Sound and

FIGURE 1.—Tonging oysters in Pamlico Sound, North Carolina, the largest sound on the Atlantic coast south of Long Island, and one of the best fishing grounds along the whole coast. (Courtesy of U. S. Bureau of Fisheries.)

sparse vegetation which separates the sound from the sea is broken by Oregon, New, Loggerhead, Hatteras, and Ocracoke Inlets. Pamlico Sound is bountifully provided with fishes and other water products and supports very valuable fisheries, participated in by a large portion of the male population. Besides being traversed by immense bodies of shad, alewives, striped bass, and other migratory fishes on their way to and from the fresh waters, Pamlico Sound is the resort of many important salt-water species, among which are the mullets, squeteagues, spot, croaker, drums, bluefish, menhaden, sheepshead, and extends southwesterly to the vicinity of Beaufort, while Bogue Sound begins at the latter place and extends westerly. These two bodies of water are upwards of 60 miles long and 1 to 6 miles wide, and, with their tributaries, have an area of about 200 square miles. The "banks" separating these sounds from the sea are very narrow and in places quite elevated, owing to the drifting of the sand. About midway, a long narrow tongue projects southward, forming Cape Lookout, the "bight" of which, on its western side, affords a fine harbor for small craft and constitutes a great natural fish trap. The waters

of this section abound with the characteristic salt-water fishes of the state, and are noted particularly for the immense quantities of mullet, squeteague, spot, croaker, whiting, drum, bluefish, Spanish mackerel and menhaden which visit them; several of these species are here taken in greater numbers than anywhere else.

Good fishing grounds exist along almost the entire coast, but fish are now mostly taken on the sandy shores near the deep holes and in the various inlets in the vicinity of the larger towns and cities. In such localities markets are easily found for the catch. Fish are more abundant in the inlets than on the outer shores. Mullet are taken along the outer and inner shores of both North and South Carolina. Bluefish are found along the entire coast from Cape Cod to southern Florida, and constitute one of the most important species south of Chesapeake Bay. There are two principal localities where bluefish are taken in gill nets in the late fall and winter. One of these is situated off Cape May, in the vicinity of Five-Fathom Bank, and the other is on the coast of North Carolina, beginning a few miles below Cape Henry and extending to Cape Hatteras Inlet.

On the south side of Cape Lookout and within a short distance of the beach, mullet, Spanish mackerel, drum, and sheepshead abound, and toward the end of the Cape, large quantities of menhaden are seined.

At and off the entrance to Beaufort Harbor there are good bluefishing grounds in summer. Eastward from the Harbor entrance, sea trout are seined for in the spring and fall. Drum and mackerel are also taken in the fall. Inside these banks sea trout, sheepshead, hogfish, and spots are taken during the fall months. West of the entrance, along the outer shore of Bogue's Banks, for a distance of two miles or more from Fort Macon, sea trout are taken in seines in the spring and summer. Inside of Fort Macon they are taken in the fall. At the entrance to Wilmington River, near Fort Caswell, and along the beach south of the Fort, a distance of 12 to 15 miles, mullet are taken in the fall in haul seines. North of Cape Fear, along the outer beach and in the waters inside, mullet, sea trout, and several other species of fish abound in their season and are fished for with gill nets and seines.

The scallop fishery is of considerable importance; the only producing grounds in the south are in the vicinity of Beaufort, North Carolina.

SOUTH CAROLINA AND GEORGIA

The states of South Carolina and Georgia, with a coast line of 250 miles, are bordered by a belt of rich grassy swamp land, separating the ocean from the higher ground of the interior. This belt, comprising the famous Sea Island region, extends almost without interruption along the entire coast of both states. It varies in breadth from 5 to 30 miles, and is broken up into an almost innumerable number of islands, separated from each other by a vast network of channels or tide creeks varying from a few feet to a mile or more in width. These channels communicate freely with each other to form a continuous inland passage. In fact, the tide creeks are everywhere so numerous along this portion of the coast that a small boat can readily pass from the lower part of North Carolina to Florida without venturing outside.

The waters of the district, like those of Florida, abound in fish of various kinds during the entire year, and the

sounds and their river tributaries are the spawning and feeding grounds of a large number of edible species. The salt-water creeks along the shore abound in shrimp and the extensive marshes and muddy bays are the homes of large numbers of terrapin.

At a distance of 10 to 20 miles from the shore, in from 10 to 18 fathoms of water, there is an irregular coral bank extending along the entire coast. It is broken up into patches several miles in extent; these are separated from each other by broad stretches of sand. The patches are covered with various species of corals and sponges common to more southerly latitudes, and among them are large numbers of mollusks and articulates. The abundance of food on the banks, together with the shelter afforded by the corals, make them the favorite feeding grounds of immense schools of fish, chief of which is the blackfish, from which the banks derive their name.

The shore fisheries of this district are very limited, being confined largely to the vicinity of Charleston and Savannah, where a market is found for the catch.

All along the shore, a distance of 10 to 15 miles on both sides of the entrance to Charleston Harbor, mullet seining is extensively carried on in the fall.

There is a group of small banks off the coasts of both states which form the most extensive off-shore fishing grounds of the entire South Atlantic. The most northerly bank of this group lies about 8 miles south-southeast of Cape Romain Light, and the most southerly lies almost due east of Savannah, about 14 miles off shore. These grounds in their geographical order are Cape Romain Bank, a small rocky patch, 8 fathoms deep, with a bottom consisting of lime rock, gravel, and willow corals. Sea bass, porgies, grunts, bluefish, sharks, sailor's choice, and spotted bass are taken. The Bank is not fished from November to June. Inner East Bank and Outer East Bank have depths of 7½ to 10 fathoms, and consist of coral rock and yellow sand. Fishing is carried on from June to December, the species taken being blackfish, porgies, jacks, and flounders.

Eastern Hole bears southeast by east, 15 miles from Charleston Light. It is about a mile in diameter, with a depth of 12 fathoms, and a bottom of lime rock, sand, and willow corals. It is fished only from October to April. Sea bass are caught chiefly in daytime and at night tom-cods, butterfish, tautog, and a few flounders are taken. Outer Southeast Ground has a bottom of coral rock, with many purple willow corals. The south side of the Ground is covered with large red shells, the east side with black and white sand. Sea bass, snappers, and jacks are taken here from November to May. Inner Southeast Bank lies in 10 fathoms of water and has a coral bottom. This is a summer bank and is a favorite feeding ground for porgies, red-mouth grunts, black grunts, tautog, sailor's choice, and cobias.

Coffin Land Ground or Inner Ground, Old Farms Ground, Outer Old Farms Ground, Inner South Ground, Outer South Ground, Edisto Bank, Blank Ground, and Tybee Ground are relatively important and supply the same varieties of fish as are found on the other grounds in this group. Fishing smacks visit one or another of these grounds throughout the entire year.

Off the Georgia coast, between Savannah and the Saint John's River, there are but three fishing grounds of any importance—Tybee Deep Wa-

ter Ground, Sapelo Ground, and Fernandina Ground. Blackfish and snappers are the principal varieties taken. These grounds are fished periodically throughout the year.

FLORIDA EAST COAST

The eastern portion of the state of Florida is a remarkably level section, rising but a few feet above the sea. Along the ocean shore the current has thrown up low sandy bars for nearly the entire length of the state; and behind these are shallow lagoons or arms of the sea, with here and there an opening to the ocean. In the still water of these lagoons many of the salt-water species find an agreeable change from the rougher water outside. Some come in to spawn, while others are led to enter the inlets in pursuit of food. During the winter months, immense quantities of fish may be found in these places, but in summer the water becomes so warm that most of them are driven out into the sea.

Fernandina, the principal coast town of Eastern Florida, is situated on Amelia Island, and has one of the largest and best harbors of the South. It was settled by the Spaniards in 1632, and still has a large Spanish population.

A few green turtles are caught during each season with cast nets in the river, their average weight being about 10 pounds. Loggerhead and hawkbill turtles are quite abundant, but little use is made of them. Shrimp and prawn are abundant in the harbor. This fishery furnishes employment to a considerable number of persons. In addition to the species taken on the outer banks, which are common to the region, trout, mullet, blackfish, bass, drum, sheepshead, croakers, sailor's choice, and eels are taken in the river.

Saint Augustine boasts the oldest fisheries in the United States, if not on the Western Continent, for the colonists who came over in 1565 must have drawn largely on the water for their food. It is not improbable that the introduction of the Spanish cast net, which is still in use in the locality, could be traced to the colony.

Mosquito Lagoon, lying to the southward of Saint Augustine, abounds in fish of various kinds, mullet being remarkably abundant. Green turtle are taken in considerable numbers, which are sent principally to New York and Philadelphia.

Indian River connects with Mosquito Lagoon by means of an artificial canal and has two outlets in its lower portion, the first being known as Indian River Outlet, and the second as Jupiter Inlet. The principal fishery is for green turtle, and they are said to be more abundant at this point than at any other on the Atlantic Coast. They are present in the river during the greater part of the year, but it is only in winter that the absence of sawfish and several of the larger species of sharks, will warrant the fishermen in engaging in their capture.

Fishing in the Saint John's River is confined largely to the capture of shad, mullet, and trout, though many other species are taken in various localities. The banks of the streams are, as a rule, low and swampy, and the fishing is therefore confined to the few higher areas. The principal fishing centers on the river are Mayport, New Berlin, Jacksonville, Palatka, Lake George, Lake Monroe, and Lake Harney.

GENERAL STATISTICS

The number of persons engaged in the fisheries of the South Atlantic

States in 1923 was 16,298, of whom 1,480 were on vessels fishing, 180 on vessels transporting fishery products, 8,614 in shore fisheries and 6,024 shoremen in the wholesale fishery trade, fish canneries, and similar industries connected with the fisheries. Of the total, 9,308 of the persons were in North Carolina, 2,164 in South Carolina, 2,019 in Georgia, and 2,807 on the east coast of Florida.

The capital invested in the fisheries of this region amounted to $8,505,259 distributed as follows: North Carolina, $4,198,894; South Carolina, $606,781; Georgia, $1,378,704; and the east coast of Florida, $2,320,880. The investment included vessels and boats valued at $2,545,644; fishing apparatus used by vessels and boats, $699,604; shore and accessory property to the value of $4,530,711; and cash capital to the amount of $729,300.

The products of the fisheries of this region amounted to 228,747,930 pounds, valued at $5,087,340. Of this total North Carolina produced 95,192,343 pounds, valued at $2,414,499; South Carolina, 6,763,279 pounds, valued at $284,791; Georgia, 39,896,386 pounds, valued at $668,129; and the east coast of Florida, 86,895,922 pounds, valued at $1,719,921.

Arranged in order of value, some of the more important fishery products are as follows: Shrimp, 23,705,901 pounds, valued at $821,861; menhaden, 148,180,870 pounds, valued at $752,026; shad, 3,190,666 pounds, valued at $716,649; oysters, from both public and private beds, 11,172,336 pounds, valued at $448,137; mullet, 7,734,412 pounds fresh and 622,000 pounds salted, valued together at $214,826; Spanish mackerel, 2,652,341 pounds, valued at $205,987; cero and kingfish, 1,966,596 pounds, valued at $161,201; and alewives or river herring, 2,609,347 pounds fresh and 4,961,050 pounds salted, valued together at $146,104.

Compared with the statistics for 1918 there was an increase of 8.3 per cent in the persons engaged, an increase of 14.6 per cent in the investment, and a decrease of 31.2 per cent in the quantity, and 4.9 per cent in the value of the products of the fisheries. In North Carolina there was an increase of 15.8 per cent in persons engaged, a decrease of 0.6 per cent in the investment, and a decrease of 54.8 per cent in the quantity, and 18.9 per cent in the value of the products. In South Carolina there was an increase of 8.2 per cent in persons engaged, 174.2 per cent in investment, and 80.5 per cent in the quantity, and 37.1 per cent in the value of fishery products. The fisheries of Georgia also showed increases in all phases of the industry; there was an increase of 20.2 per cent in persons engaged, 79 per cent in the investment, 7.4 per cent in the quantity, and 60.6 per cent in the value of the production. On the east coast of Florida there was a decrease of 15.7 per cent in persons engaged, an increase of 5 per cent in the investment, an increase of 7 per cent in quantity of fishery products, and a decrease of 1.5 per cent in the value of the products.

Practically all the decrease in production may be attributed to a failure in the menhaden fishery, which in 1923 produced only 148,180,970 pounds as compared with 257,757,799 pounds in 1918. Other fishes showing a severe decrease since 1918 are alewives, cero, and kingfish, red and black drum, mullet, and Spanish mackerel. The yield of shad and squeteague or "sea trout" increased somewhat, and the production of

shrimp and oysters was greatly increased over that of 1918.

FISHERIES OF THE GULF STATES

The Gulf region has a coast line very much longer than that of any other geographical division of the coast states. Taking into consideration the principal indentations, its approximate length is 6,875 miles, while the Middle Atlantic States, which rank next in this respect, have only 5,400 miles of coast, including the rivers to the limits of commercial fishing. The shores of this entire section are low, and for the most part sandy and swampy, sterile sandy beaches and shallow bayous being characteristic features of the coast.

The Gulf States occupy a favorable location for supplying a large part of the country with marine products. A dozen or more states in the lower Mississippi Valley have their nearest coastal connections through these states, and it will probably be in response to this section's demand for marine food products that the Gulf fisheries will reach their highest development.

This region is favored with many highly esteemed food fishes, which occur here in greater abundance than elsewhere on the coasts of the United States; among these the sheepshead, pompano, red snappers, and groupers may be mentioned. The possibilities of the region in the matter of oyster production and cultivation are believed to be great, though there are, in some localities, certain difficulties to be encountered and natural limitations which may somewhat retard rapid development.

The fisheries of this region are not especially important when compared with those of the other geographical divisions of the coast states. Nevertheless, the Gulf fisheries are remarkable for their recent wonderful growth and for the possibilities of greater advancement in the future.

FIGURE 2.—Lifting the catch in haul seine fishing. This method of fishing is so common along the coast of the Southern States, that it may be called the characteristic means of capture along the Gulf Coast. (Courtesy of U. S. Bureau of Fisheries.)

APPARATUS OF CAPTURE

The haul seine is the most extensively used device in taking fish proper; it is so generally employed in all the states—in some of them almost to the exclusion of other forms—that it may be called the characteristic means of capture in the Gulf region. The gill net is an unimportant form of apparatus except in Florida, where it yields greater results than the seine. Such minor devices as the cast net and the dip net are mostly employed by semi-professional fishermen and take but small quantities of fish; they are most commonly used in Louisiana.

Both in Louisiana and Florida, lines constitute a very prominent means of capture; in the former state, they take larger quantities of fish than any other kind of apparatus.

Such implements as are used in the oyster, sponge, and similar fisheries, in addition to being the least expensive, are naturally the most productive. In every state but Texas they yield much larger returns than any

other form of apparatus, and in Florida give greater results than all the other kinds combined.

Pound nets, trap nets, weirs, and fyke nets, which are so prominent in the fisheries of other portions of the United States coast, are entirely absent from the Gulf States west of Florida. The large predaceous fish, such as the tarpon, sharks, alligator gars, and jewfish which abound in the Gulf waters, would damage the nets to the extent of making them useless for the capture of marketable species. The teredo also is abundant and would prove very destructive to the poles. The destructive influence which the high temperature of the water in the subtropical region has on twine is another factor which tends to discourage the use of stationary nets. It may be stated that one of the reasons why gill nets are not more extensively used in this region is the abundance of crabs, garfish, and numerous other species which do no great injury to the nets, but are always present to attack and destroy the fish that are gilled.

FIGURE 3.—Bunting the fish in a pound net. Pound fisheries are extensive in the Sound system of North Carolina. (Courtesy of U. S. Bureau of Fisheries.)

THE VESSELS

In some respects the fishing fleets of this region differ from those employed in other sections of the United States, although it is true that here, as elsewhere, schooners are more universally employed in the fisheries than any other class of vessel. In Florida a large number of the fleets are northern-built crafts. This applies more particularly to the vessels employed in the red-snapper and grouper fisheries, which are typical New England schooners, though usually of comparatively small size. But, while these are generally deep-keel vessels, the greater number of the schooners employed in the oyster and sponge fisheries are shallow, centerboard craft, many of them being built in this region for the special trade for which they are employed.

Steam has not yet become an important factor in the fisheries of this region. A few small steamers are used, mostly to transport the catch of fishing gangs to market.

The sloop rig is still in favor for sailing vessels of comparatively small tonnage. These sloops are mostly wide, shallow, centerboard vessels; and it may be remarked that the general character of the coast necessitates the employment of craft with light draft. This is emphasized by the employment of large sharpies about Tampa, Florida, averaging 7 or 8 tons burden.

The Gulf region is remarkable for the employment of a large number of small lug-rigged vessels of about 7 tons burden. These are found mostly in Mississippi and Louisiana. The typical lugger is a sharp, shallow, centerboard craft, carrying a single large lugsail. Vessels of this rig are celebrated for speed and general fitness for the work they have to perform. They are manned chiefly by fishermen of foreign birth.

Crustaceans

Among crustaceans the shrimp is the most prominent. It is taken on all the coasts of the Gulf States. The shrimp are used fresh, and are also preserved by drying and canning. Crabs are abundant in this region; in addition to the blue crab, common to the Atlantic Coast, there occur the shore crab, the lady or sand crab, and other species of less importance. The fishermen of Louisiana secure larger quantities of crabs than those of Mississippi and Texas, the only other Gulf States in which this fishery is carried on. The stone crab, which reaches a large size and is very palatable, is probably most abundant on the coast of Florida, where it is a highly esteemed food among the coast inhabitants, but it is not sought to a very great extent for commercial purposes. The lady crab is very common in Louisiana waters, and is a favorite product in New Orleans. Several species of crayfish exist in the brackish and fresh waters of the gulf region, but it is only in Louisiana that they are caught for market. In southern Florida the fishermen take considerable quantities of spiney lobster, locally called "crawfish," which are mostly used for bait, and are sparingly eaten.

Reptiles

The economic value of the reptiles inhabiting the Gulf States is larger than in any other section. Foremost among them is the alligator, which occurs in every state, but is of commercial importance only in Florida and Louisiana. The crocodile is also found in Florida, and is occasionally, though very rarely, taken. There are at least five species of terrapin in this section which are valuable as food. Four of these occur in fresh water, one of which, the "mobilian," reaches a length of 16 inches and is very highly esteemed, especially in New Orleans, Mobile, and the other southern cities. The salt-water or diamond-back terrapin is also found in the salt marshes from Florida to Texas, and is a valuable object of fishery. This region is included in the range of three soft-shell tortoises, which are chiefly found in shallow, sluggish streams with muddy bottoms; both their flesh and eggs rank high as articles of food. Two species of snapping turtle also inhabit the fresh waters of these states and are sometimes captured. Three important marine turtles frequent the Gulf of Mexico and are sought by the fishermen of nearly every state; these are the green turtle, the loggerhead turtle, and the hawkbill or tortoise-shell turtle. The loggerhead turtle often attains a weight of 1,600 pounds, but the average weight is very much less; the green turtle is intermediate in size between the hawkbill and the loggerhead.

Important Fishes

Taking the region as a whole, the most prominent fish is the mullet, although this is relatively important only in Florida. Of the fish that are generally distributed and are taken in greater or lesser quantities in each state, the squeteague or trout ranks first, followed by the sheepshead and the red fish or channel bass. Other valuable species are the bluefish, buffalo fish, catfish, croakers, grunts, pompano, red snapper, and Spanish mackerel. The most important of these is the red snapper, the catch of which exceeds all other species except the mullet. In addition to the foregoing, there is a great variety of other

FIGURE 4.—Red Snappers and Groupers on the deck of a Gulf schooner. (Courtesy of Capt. F. W. Wallace.)

species, some of which are more or less peculiar to this region, such as the minor snappers, groupers, lady fish, whiting, drum, pinfish, sailor's choice, jurel, grunts, angel fish, and sea bass.

FLORIDA WEST COAST

Key West was settled in 1822, and from the very beginning of its existence fishing formed one of its principal industries. At the present time fishing is, perhaps, of first importance to the inhabitants, although in value of output it is exceeded by the cigar industry.

Fishing equipment and methods of distribution are practically identical with those of fifty years ago. Indeed many of the small craft now in use are at least forty years old. The only fisheries which have shown noteworthy developments within the past half century are those of the spiny lobster and the Spanish mackerel.

Most of the wholesale trade in fish is carried on during the winter months, when perhaps 90 per cent of the annual catch of fish is taken. Several dealers operate during the entire year, but others are actively engaged in Key West only during the winter. Dealers in sponges and turtles operate throughout the year. All the wholesaling is done with dealers outside the city.

It was not until 1920 that an ice-making and cold-storage plant was built to take care of excess catches of fish. Previous to that time, notably in 1919, the fishing industry suffered severe losses when the one small ice-making plant in the city became disabled.

There are no local retail stores that sell fish, but small quantities are peddled in pushcarts throughout the city. Live fish are sold at retail at the wharves, where the fishermen keep their stocks alive in well-boats or live cars.

The fishing fleet is composed mainly of small boats, some of which are equipped with sails only, some with gasoline engines, and some with a combination of the two. These boats seldom travel far from land and are used chiefly in fishing on the nearby reefs which are numerous about Key West. Very few boats of the larger and better type are owned locally, but a number of such vessels come from the east and west coasts of Florida to fish at Key West during the winter. These boats range from 20 to 75 feet in length, from the half-cabin dory type to the small schooner, and carry a crew of two to five men. Fishing is done entirely with hook and line.

A portion of the catch is sold in Key West, but the greater part is shipped to Cuba and to various cities of the United States.

The southern and easternmost of the fishing grounds of the Gulf Coast are those of the Florida Reefs, which are mainly visited by the Key West market fleet. These reefs, as a natural consequence of their coral formation and the protection afforded by their uneven surfaces, are exceedingly well populated with all the forms of invertebrate animals common to this latitude, and, therefore, we find about

them an abundance of fishes, attracted by the vast stores of food. On the Gulf Stream side of the Keys all forms of animal life exist in greater abundance than on the opposite side, owing probably to the greater depth, clearness, and warmth of the water. In the narrow channels through the reefs, and about the solitary rocks and clusters of rocks, the best fishing grounds usually exist. Some species of fish, however, swim in open water in search of prey, and others along the bottoms of channels, while others obtain their food from the sides of high-standing rocks and in shoal water.

Proceeding northward in the Gulf from the Florida Reefs fishing grounds, we find innumerable places for sea fishing, which follow one another so continuously from the Tortugas Keys to the mouth of the Mississippi River, that the entire region can be best described as an extensive fishing ground in the form of a broad belt following the general contour of the coast.

Along the coast from Anclote Keys to Charlotte Harbor there exist extensive and continuous lines of ledges, upon which, as well as in gullies between, fish abound. The same kind of bottom is again found just north of the Florida Reefs, but between the two regions there is an almost barren waste of sand.

The fishing grounds on the offshore limit of this section are, so far as known, in the gullies between the rocks where there are living corals, or else in gullies with sandy and shelly bottoms also containing living corals and a soft rock formation.

The grounds of the northern portion, embracing the region between Anclote Keys and the mouth of the Mississippi River, are wholly in gullies. The bottom, off to a depth of about 20 fathoms, generally consists of sand with an admixture of broken shells, but in the gullies, the bottom is covered with living corals or hard rock. Outside of about 20 fathoms, rocky and coral bottom predominates, and the soundings show it to be very uneven. At some places in this northern portion the small gullies or gulches are found quite near to the coast, as, for instance, off Appalachee Bay, Dog Island, and Crooked Island, off the coast between Saint Andrew's and Choctawhatchee Bays, and off Pensacola, where they occur in from 5 to 10 fathoms of water.

The deepest waters in which fishing is carried on in the Gulf are off Pensacola, in a southeast direction and in a depth of nearly 50 fathoms.

THE FLORIDA SPONGE FISHERY

The Florida sponging grounds form three separate and elongate stretches along the southern and western coasts of the state. The first includes nearly all the Florida Reefs; the second extends from Anolete Keys to Cedar Keys, and the third from just north of Cedar Keys to Saint Mark's, in Appalachee Bay. The Florida Reef grounds have a linear extent of about 120 miles, beginning near Key Biscayne, in the northeast, and ending in the south, at Northeast Channel, just west of Key West. The northeastern half of the grounds are very narrow, having an average width of only about 5 miles, and being limited to the outer side of the reefs. At about the Metacumbe Keys the grounds broaden out so as to cover the entire width of the reefs, which are much broader here than in the north. The entire southern half of the grounds have more or less the

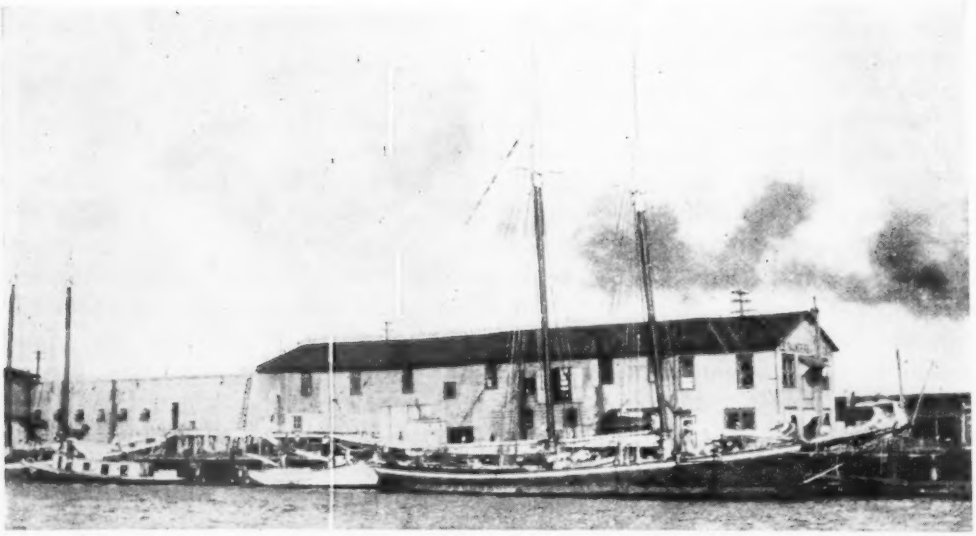

FIGURE 5.—A Pensacola fishery plant. The schooner is employed in the Red Snapper fishery of the Gulf. (Courtesy of Capt. F. W. Wallace.)

same breadth, which is about 13 or 14 miles.

The second sponge ground begins just south of Anclote Keys, with a breadth of 7 or 8 miles, but rapidly broaden out toward the north to a width of 15 miles, which it maintains from a point about opposite Bay Port to Sea Horse Reef, just south of Cedar Keys. The total length of this sponging ground is about 60 geographical miles. Its distance from the shore varies somewhat; at the south the inner edge approaches within 4 or 5 miles of the mainland, and comes close upon Anclote Keys; but throughout the remainder of its extent it is distant from 6 to 8 miles from the shore, until it touches the shallow bottom and reefs of Cedar Keys. The depth of water on these grounds, as indicated on the Coast Survey Charts, ranges from 3 to 6 fathoms, but many portions are undoubtedly shallower than this.

The northern sponging ground, which maintains a nearly uniform width throughout, is about 70 miles long by about 15 miles broad. It approaches to within about 5 miles of the shore, and terminates just off the mouth of Saint Mark's River. The depth of water upon these grounds is from 3 to 5 fathoms.

The total area of the Florida sponging grounds, including those now being worked and also those that were formerly fished but have since been more or less abandoned, may be roughly stated at about three thousand square geographical miles. This does not, however, probably indicate the entire extent of the sponging grounds of the Florida waters, for the fact that new grounds are being constantly discovered would indicate that there might be still more to find, and it is certain that no very strenuous efforts have been made to extend the already known grounds, the discovery of new sections generally having been made by accident.

Methods of the Fishery

In Florida two methods are used in gathering sponges, diving and hook-

ing. A sponge diver's outfit generally consists of a schooner of between 10 and 20 tons register and one or two machine boats. The schooner is used as living quarters for the crew and a place of deposit for the sponges. The machine boats carry the usual diving apparatus and are of the Greek type, with high bows and sterns. The diving dress consists of a helmet, rubber suit, breast plate, shoes, and weights. A diving crew is usually made up of a captain, deckhand, cook, and four to six divers. A majority of these boats operate from Tarpon Springs.

The divers generally operate at a depth of 10 fathoms or less, and remain down for two hours at a time. As there are two divers to a boat, each man works for about two hours and rests for a like period. At greater depths the working time is shorter and the rests longer. The sponges are gathered by hand and placed in a net basket which is pulled to the surface from time to time to be emptied. Divers often work in places that are inaccessible to the "hookers," and it is probable that the sponges found in such localities could not be obtained by any other method. The boats often remain away for one or two months, but sometimes a good catch is made in a week.

The Key West fishermen use the sponge hook almost exclusively. Prior to 1905 all sponges in this country were taken with hooks, but diving has proven so much superior that the old method is now of small importance in the fishery.

FIGURE 6.—A harvest of sponges from Atlantic waters. After the sponges have been thoroughly cleansed, they are spread out on platforms or on the ground to dry in the sun. Tarpon Springs, Florida, is the principal sponge market of America. (Courtesy of U. S. Bureau of Fisheries.)

The sponge hook has the one advantage that it can be used by one or two men and at practically no expense. The hook is attached to a pole of convenient length and has three tines bent at right angles to the handle, so that a sponge can be lifted perpendicularly from the bottom. The typical hook fisherman has a sloop 25 to 40 feet long on which he lives, and a 12- to 14-foot dory in which he works. Sails are generally

depended upon in going to and from the grounds, as only a few of the boats are equipped with auxiliary engines.

The hook fisherman usually operates among the Keys where the water is clear and about 1 to 2½ fathoms in depth. Except when the water is very smooth a sponge glass (that is, a wooden bucket with a glass bottom) is used for locating the sponges. When two men work together the hooker remains in the bow with the sponge glass and directs his companion in the movements of the boat. Sometimes one man works independently, in which case he weights the stern of the dory with iron and propels the boat by pushing on the bottom with his sponge hook. It is seldom that a fisherman working alone is able to use a sponge glass.

When removing sponges from the bottom, care must be taken not to mutilate them. Sometimes they are firmly attached, and the sponge hook either fails to dislodge them or tears them in such a way that their value is materially reduced. The diver, since he gathers them by hand, is able to take most of his sponges in perfect condition.

The sponge as an article of commerce is merely the skeleton of the living animal, and is of very different appearance than when first removed from the water. When first taken, it is a comparatively heavy mass of living matter, most of the porousness of the market sponge being filled with live animal tissue. The color of the live commercial sponges is usually dark brown or black.

After the sponges have been taken aboard the deposit boat, they are laid on deck, where they undergo a three- or four-day exposure to the air to kill all the living tissue. In this state decomposition sets in and some of the liquid organic matter drains away. It is advantageous to shade the sponges, or the sun will quickly dry the outside skin and render the subsequent cleaning more difficult. After sufficient exposure they are beaten with a heavy short club to loosen the remaining skin, dead tissue, and foreign matter. They are then strung on strong cord and thrown overboard, where they are allowed to macerate by the action of the tide. Another method of cleaning sponges by tide action is to place them in crawls. Crawls are small enclosures made with stakes set closely together in shallow water generally very near to the shore.

The final preparation of the sponges consists of scraping off the remaining particles of outside skin with a dull knife, and with a stout club the small pieces of shell, coral, and other matter are pounded out of the skeleton. Water is then taken up and squeezed through them a number of times, and after being strung in bunches, they are ready for the auction market.

Inferior sponges can be readily distinguished by the red-brown color of the inner fiber. In some sponges this reddening is found only at the root, but in the most inferior, it penetrates well into the body. The best quality sponges are of a greyish hue throughout, although some may show a reddish spot at the point of attachment to the ocean bed. The color itself, however, is one of the least important factors in determining the value of a sponge. A fine sponge is determined by the following characteristics: size and shape, softness, fineness, toughness, durability, resiliency, and absorptiveness.

In 1925 the quantity of sponges sold at the sponge exchange, Tarpon

Springs, Florida, was 434,672 pounds, valued at $715,097, of which 242,020 pounds, valued at $609,393, were large wool; 29,968 pounds, valued at $44,952, were small wool; 120,748 pounds, valued at $48,300, yellow; 28,622 pounds, valued at $8,014, grass; and 13,314 pounds, valued at $4,438, wire. Compared with the 1924 production this is an increase of 2 per cent in quantity and less than 1 per cent in value. It is estimated that sponges valued at $50,000 were sold outside the exchange at Tarpon Springs.

THE CLAM INDUSTRY OF SOUTHERN FLORIDA

What is probably the largest bed of hard clams in the United States is to be found off the southwest coast of Florida, in the region of the Ten Thousand Islands. The bed is about 40 miles long and 5 miles wide, and it is estimated to contain an area of nearly 150 square miles which produces clams. The southern part of this bed is about 70 miles from Key West.

The Florida hard clam (*Venus mercenaria mortoni*) bears a close resemblance to the New England quahaug (*V. mercenaria*). It is difficult to separate the two varieties when comparing specimens 3 or 3½ inches in length, but in general the southern clam attains a larger size and has a thicker and heavier shell. It is not unusual to find these clams weighing more than two pounds each.

Clams are found in varying abundance from Gullivan's Bay to Shark Point. The bed gradually widens from Coon Key to Pavilion Key, and thence continues to Porpoise Point, after which it narrows until Shark Point is reached. Below Shark Point the bottom is mostly of firm sand and is unsuitable for the growth of clams.

The clams are very plentiful over a large part of the bed, and no difficulty is encountered in finding a suitable locality for digging. The areas of greatest abundance occur immediately north to northwest of Pavilion Key, between Seminole and Porpoise Points, and west of Clam Point. There are places where few or no clams are found, and as a rule none are present within a few hundred feet of shore.

Along the coast of the Ten Thousand Islands the shore slopes very gradually into the Gulf. At one mile off shore the depth varies from 4 to 7 feet at mean low tide, and from there to the 5-mile line the slope is about 2 feet per mile. Because of this small depth of water, the clams can readily be taken over the entire bar. The off-shore part of the bed, however, has never been worked, for clams are to be found in great abundance near shore where the water is very shallow and protection is afforded from the sea.

Two methods are used in procuring the clams, hand digging and dredging. No tongs are used in this region, for the clams are too abundant and accessible to require such apparatus. Furthermore, the consistency of the soil, which is sticky mud, would render tonging difficult.

Hand digging can be done at all times, except, perhaps, when the tide is at its highest point. The diggers keep pace with the tides, working away from shore during the ebb and toward the shore during the flood. To work with any degree of comfort, the maximum depth of water should not be much greater than an arm's length.

The clams are located by wading

about in the water, for which reason this method is sometimes called "treading clams." When a clam is located with the foot, it is removed from the mud with a two-tined fork having a 6-inch handle. Each hand digger is equipped with a small flat-bottom boat in which the clams are deposited as they are dug. When a boat is filled, it is poled or pushed to shore, where the clams are cached in shallow water to await the arrival of a "run-boat" that takes them to the canneries.

Dredging is by far the most efficient method of procuring clams. The dredge used in this section is of a unique type, one that is not used in any other part of the world. In general appearance it resembles a house-boat. It is 90 feet long and 20 feet wide, and has two stories. The machinery is located in one end of the boat, the digger in the middle, and the other end is a storage place for the clams. The second story is devoted to sleeping quarters and mess room.

The digger consists of a power-driven chain belt equipped with rows of iron teeth, 6 inches in length, set at an angle to the floor of the dredge. As the belt revolves each row of teeth digs into the bottom and carries up clams and soil which, on the downward turn, are deposited on a moving wooden conveyor, the receiving end of which is under water. As the conveyor moves upward through the water to the floor of the boat the clams are partially cleansed of mud and are more easily handled by the pickers. The clams are picked from the moving conveyor and the remaining mud and dead shells are automatically dumped back into the sea.

Practically all the clams produced in this region are utilized by two canneries, one of which is located at Marco and the other at Caxambas, in Lee County. The Marco cannery has an annual capacity of 100,000 cases of clam preparations, but the Caxambas factory is somewhat smaller.

NORTHERN FISHING GROUNDS OF THE GULF

The region from Appalachee Bay to the mouth of the Mississippi River has an almost unbroken shore that is suitable for seining. As a result, there are few permanent stations, and the fishing is carried on from small vessels and boats that accommodate the crew and their catch while on short trips from the nearest markets.

West of the Mississippi, off the coasts of Louisiana and Texas, the bottom is generally muddy with but a very few small patches of rock. The shores in this region are mainly uneven and marshy with an occasional sand-bar suitably located for beach-seine fishing. These sand-bars or seining flats lie in the thoroughfares of schooling fishes, and those located nearest the markets are the most used and have the most elaborate and complete outfits.

TEXAS

The length of the Texas coast line, following its sinuosities, is about 2,000 miles, but in a direct line it is a trifle less than 400 miles. The mainland is, for the most part, bordered by a chain of low sandy islands and peninsulas, each having the same general trend as the coast. The most important of these are Boliver Peninsula, Galveston Island, Matagorda Peninsula, Matagorda Islands, Saint Joseph Island, Mustang Island, and Padre Island. On nearly all of these there are a few scattering houses, the homes of men employed in fishing,

cattle raising, and the Coast Guard Service. There are no important settlements on any of them except Galveston Island, on which the city of Galveston is located.

Between the mainland and the outlying chain of islands and peninsulas are situated a number of bays, viz., Galveston, Matagorda, Espiritu Santo, San Antonio, Mesquit, Aransas, Corpus Christi, and Laguna Madre; also, Sabine Lake in the extreme eastern part of the state; this, however, is an extension of the Sabine River, rather than a bay. The combined area of these bays with their estuaries is 2,471, square miles. In nearly every instance, the outlets of the bays are situated at the extreme southwest end.

From Matagorda Bay through Espiritu Santo, San Antonio, Mesquit, and Aransas Bays, to Corpus Christi Bay, a distance of 130 miles, there is an inside route permitting the passage of vessels, drawing not more than three feet of water, and connecting advantageously the industries of these six bays. The remaining bays, Galveston Bay, Laguna Madre, and Sabine Lake are isolated and without inland water routes.

The easternmost fishing locality in Texas is Sabine Lake, which forms a part of the boundary line between this state and Louisiana. This lake is merely an expansion of the Sabine River just before its entrance into the Gulf of Mexico. As the Sabine River, which is about 400 miles long and forms about 200 miles of the boundary line between Louisiana and Texas, and the Neches River, which is 270 miles long, empties into Sabine Lake, the water of the lake is comparatively sweet, especially during spring freshets.

Fishing operations in this section are not very extensive, not more than a sufficient supply for local consumption being taken.

On account of the slight density of the water, no oysters are found here, except occasionally in the lower end of the lake. The reefs on which oysters appear are at the extreme southern end of the lake and directly in the "Pass." They cover an area of from 2 to 3 miles long and about three-quarters of a mile wide, the length running north and south.

The coast from Sabine Lake to Galveston Bay, a distance of 60 miles is entirely without harbors, and there are no fishing localities along this stretch of coast.

In former years there was a great abundance of fish in Galveston Bay, but in more recent years the crews seining here catch on an average a smaller quantity per seine than those in the other important fishing sections along the coast. Although quantities of fish are shipped into the interior from Galveston Bay, yet at times the catch is not sufficient to supply the local demand, and large consignments are received from other fishing ports. The great bulk of the catch is sold in Galveston City, but occasionally some of the boats run up Buffalo Bayou and dispose of their catch at Houston, while a few fish are sold at Wallisville, Harrisburg, and the other villages on the shores of Galveston Bay. More of the so-called "cheap fish" are sold by Galveston Bay fishermen than elsewhere along the coast. This is due to the larger local demand among poor people.

A GROWING INDUSTRY

At present "bay seining" is the most important fishery in Texas. The oyster industry is second in ex-

tent, but will doubtless rank first within a few years. These two fisheries are prosecuted extensively all along the coast. Each locality has its own minor fisheries, such as the turtle, the shrimp, the crab, the surf seine, the cast net, and the hook and line.

Aside from the surf seines in use on Galveston Island, some hook and line fishing at different places, and an occasional trip of a harbor boat from Galveston to the red snapper banks, all the fisheries of Texas are confined to the bays and their estuaries along the coast. Of the total quantity of marine products obtained by Texas fishermen annually about 96 per cent are taken from inshore waters and the other 4 per cent from the Gulf proper.

Since 1880 all the Texas fisheries have increased in extent, excepting for shrimp, which are reported to be less abundant. The growth of the fisheries is due principally to the development of the methods of marketing the catch. The shipping facilities along the coast have been greatly increased during the past thirty years, and the establishment of ice manufacturing plants at important fishing centers, have been of great benefit to the industry.

FIGURE 7.—On a "Snapper" Fisherman, Gulf of Mexico, a small haul. (Courtesy of Capt. F. W. Wallace.)

THE FISHERMEN

Only a small portion of the Texas fishermen were born in America; they are chiefly natives of Italy, Sicily, Greece, and Mexico. Of the native fishermen, a large proportion are of foreign parentage. A much greater proportion of native Americans is engaged in taking oysters than in the seine fishery. The negroes along the coast do not engage in fishing, except in a small way from the wharves with cast nets and lines.

The fishermen as a rule are not familiar with other occupations. Many of them have inherited their vocations by direct descent for many generations. Prior to their coming to Texas some of them have fished for the markets of Palermo, Naples, or Athens, or have supplied fish at such Mexican towns as Vera Cruz, Tampico, or Sata la Marina. As a class they are independent in their manners and habits, but are nearly always poor and unthrifty. Their life while on a fishing trip is very rough. The hard, rounding floor of the cabin, with a blanket over it, serves as a bed. The provisions, while usually plentiful, are of the plainest, consisting chiefly of salt meat, bread, hard-tack, onions and garlic, potatoes and coffee. The cabin floor serves as a table. The cooking is generally done on a small stove or by an open fire in a pot, and one of the crew attends to that part of the work without extra pay.

FISHING VESSELS AND BOATS

Along the Texas Coast the expression "boat" is applied to all sail craft, while the word "skiff" is used to designate something propelled by oars. The sloop, cat, and schooner rigged centerboard boats are the prevailing types employed in the oyster, seine, and turtle fisheries. Square, or "lugger" rigged boats, are not in use at present in the fisheries of this state. The lugger is particularly adapted to winding bayous, where sailing close to the wind is necessary, as in Louisiana, and as few such places occur in the fishing regions of Texas, the safer and more speedy sloop and cat rigged boats are obviously preferable.

The construction and rig of the sailboats do not materially differ from the style in general use along the coast of the Middle Atlantic and New England States. In order to easily pass through the shoal waters of the bays, these boats are built very shallow, having either a flat or "round knuckle" (one-half of flat) bottom. They are usually from 22 to 34 feet long, from 8 to 12 feet wide, and from 1½ to 3 feet deep. These boats are without elaborate or unnecessary finish or equipment. They are decked over fore and aft, and frequently over the entire length. All of them have a small cabin, which serves as a cooking and sleeping room. Each sailboat carries one or two skiffs or tenders. These skiffs are roughly constructed, many not being painted. All of them have flat bottoms, so that they may be easily run ashore.

Occasionally, under the influence of a southeast wind, some of the bays become exceedingly rough. Especially is this true of Madagorda Bay, which in threatening weather the fishermen avoid almost as much as they would the open gulf. More wrecks have probably occurred in this bay than in all the other remaining bays of the state combined. As the boats are never insured, their loss is a serious matter to the fishermen.

THE FISHERIES

The bay-seine fishery is the most important in Texas. It is prosecuted in the same manner and with the same form of apparatus in all the fishing sections along the coast. These seines are hauled in all the bays along the coast, but are never used in the Gulf or in the rivers.

Each party of seine fishermen, which usually consists of from two to four men, ordinarily has one sailboat, one seine, one or two skiffs, and two or more live-fish cars. The sailboats and skiffs are of the ordinary type used in all the fisheries along this coast. The sailboats never have "wells" in which the fish may be kept alive, and ice is not used for preserving the catch; but floating cars are used in which the fish are kept alive while being transported to market. These cars are roughly constructed, usually of slats in the form of and about the same size as a skiff. Some of the fishermen use an old skiff, cutting or boring holes in it and covering it with an open slat top. The live-fish cars have capacity for 400 to 2,000 pounds of fish, according to their size and the temperature of the water. They are carried on board the sailboats when empty of fish, and when the fish are put in them they are towed behind.

The seines vary in length from 80 to 200 fathoms and from 4½ to 6 feet in depth. This small depth is made necessary by the shallowness of the

water. Usually no lead or similar weight is attached to the bottom, the sinker consisting of a tarred rope about an inch in diameter; but some of the seines have several lead sinkers on the tarred rope, near the middle. In the center of each seine is a cone-shaped bag from 10 to 15 feet in length, and 3 or more feet wide where it joins the bunt, tapering to 6 inches at the smaller end.

The ordinary mesh of the seine is 1½ inches square, but the net used in the bag and for a distance of 12 feet on each side, has a mesh of about three-fourths inches square. This smaller mesh is necessary to increase the strength of the seine in those places to prevent its being torn by alligator gars and tarpon. A seine usually lasts about two years, but requires constant mending and repairing.

The fishermen generally work on shares and sell their catch to the marketmen at a price which is fixed for the season. In dividing the profits as well as meeting the expenses, all the crew share alike. The captain receives no more than any one of his men, and his duties are equally laborious. The boat and seine, which are generally owned by the captain or some relative or friend, count for one share. The seine is kept in good order by the crew, and the owner pays for such expenses as repairing the boat and keeping it painted.

The bay-seine fishery is prosecuted during all seasons of the year, but less zealously in the summer on account of the smaller demand for fish. The principal species of fish taken by means of these seines are redfish, sea trout, sand trout, sheepshead, croakers, jackfish, hogfish, drum, mullet, bluefish, Spanish mackerel, pompano, rockfish, jewfish, pigfish, and whiting.

FIGURE 8.—Reels employed for drying seines. (Courtesy of U. S. Bureau of Fisheries.)

The following species are also reported as being taken in small quantities: shoemaker, perch, pike, flat croaker, robalo, sawfish, catfish, calico fish, needle fish, moonfish, gulf menhaden, and crabs. Most of these species are considered of no value and are thrown away as soon as removed from the seines, except occasionally when the better kinds of fish are scarce.

By far the greater part of the fish brought to market by the bay-seine fishermen consists of redfish, sea trout or squeteague, and sheepshead. Of these the trout is generally considered the finest for the table, but it does not bear transportation as well as some of the other species. The red fish is preferred for shipping purposes, and is much more popular for the table than the sheepshead, which at times does not meet with a ready sale.

The cast-net fishery is of minor importance and no one depends on it for a living; yet numbers of these nets are used in the various settlements along the coast. These nets are circular, varying in diameter from 4 to 10 feet. Each net has a small ring in the center, through which pass several small ropes which are attached to the outside rim of the net. After passing through this ring, which

is usually made of horn, the ropes are all united and fastened to one larger rope, which is used as a hand line. Around the edge of the net a number of lead sinkers are arranged at equal distances from each other. The average size of the mesh is about one inch, and cotton twine is the material usually preferred in their construction.

With the hand line on the ground under one foot or otherwise secured, the net is held at different places on the rim by the mouth and the two hands; then, with a circular motion, it is thrown so as to fall flat upon the surface of the water. Sinking to the bottom it covers such fish as are unable to make their escape from beneath it. Then, by hauling in the main rope or hand line, the net is pursed and the fish are enclosed.

Hook-and-line fishing is not as extensive as seining, although from all the bays along the coast and in the many rivers throughout the state, quantities of fish are taken in this way by sportsmen as well as by those who engage in the other fisheries.

Catfish are taken on trot lines and by means of hand lines in Sabine Lake, Guadalupe River, Rio Grande, and to a less extent in many other streams. These are the large mud or channel catfish common in the Mississippi River and the Southern States. They sometimes attain a weight of 50 and even 70 pounds. They are quite well liked in this state, and in some of the interior towns are preferred to the redfish or trout.

Some line fishing in the surf is engaged in on the south side of Galveston Island, and at one or two other places. From all the coast settlements some hand lines are used for taking redfish, trout, sheepshead, tarpon, and other species common to the coast. More redfish are taken in this manner than any other single species, mullet and shrimp being the most popular baits used for them.

FIGURE 9.—Hauling trawl line, Red Snapper fishery. (Courtesy of Capt. F. W. Wallace.)

The tarpon, known in Texas also as "grande ecaille" or "savanilla," are abundant, but not frequently landed. Jewfish attract much attention in the spring. The Mexican fishermen call this fish the "guasa," and at Pensacola it is known by the name of "warsaw," which is doubtless a corruption of "guasa." In Texas it is also called the "junefish," because of its being more plentiful in June than at any other time. Crabs and mullets are used as bait.

The flounder fishery is prosecuted mostly at night by means of spears. The men wade out in the shallow water carrying lighted torches, and

using flounder spears or some similar instruments of capture. Many forms of spears are used; in some cases the fisherman employs an ordinary table fork fastened to a stick, while others, and probably the most successful ones, use a table fork without the extra stick, merely grasping it by the handle.

THE RED-SNAPPER FISHERY

"Outside fishing" from vessels is also engaged in, the species sought being the red snapper. All along the coast of Texas from Sabine Pass to the mouth of the Rio Grande there is an irregular series of banks or reefs, on which these fish may be taken. Due south from Sabine Pass and about 13 miles distant, there is a small reef on which vessels from Galveston occasionally fish; the depth of water on this reef varies from 7 to 12 fathoms. Off Galveston Island there are two banks, one southeast and distant about 45 miles, in 12 fathoms of water; the other about 85 miles south of the Island, with a depth of 30 to 45 fathoms of water. Southeast of Cedar Bayou, in 15 fathoms of water, there is a small bank, upon which a few fishermen operate occasionally. A small reef a few miles south of the entrance to Aransas Bay attracts some attention.

It is highly probable that all along the coast of Texas and Mexico there are innumerable small patches of sea bottom where red snappers and groupers may be taken. Off Sabine Pass and Galveston Island the reefs range from 5 to 100 miles off shore. Going southwest along the coast, the width of the area becomes gradually smaller, the limits of the reefs being nearer the shore. Off Padre Island there are no snapper banks at a greater distance from the shore than 55 miles.

The grounds north and west of Yucatan constitute the well-known Campeche Banks, which have a reputation of being abundantly supplied with fish, particularly with the red snapper.

THE OYSTER INDUSTRY

For many years oysters have been taken in nearly all the estuaries along the Texas coast. At low tide the wharf posts and pilings, the buoy stakes, and the reefs left bare by the receding water, are seen to be covered with small oysters. At times, particularly in the spring, when heavy freshets occur and fill the bays with fresh water, many of the oysters are destroyed; but this rarely happens to all the reefs in any one bay during the same year, and within two or three

FISHERIES OF THE GULF STATES, 1923

Items	Florida (West Coast)		Alabama		Mississippi		Louisiana		Texas		Total	
	Number	Value	Number	Value	Number	Value	Number	Value	Number	Value	Number	Value
Persons engaged	4,854	.....	568	.....	1,700	.....	2,611	.....	1,399	.....	11,132	.....
Vessels, fishing	98	723,876	17	57,485	143	259,485	59	109,100	32	229,900	349	1,379,846
Tonnage	2,640	.....	250	.....	1,992	.....	394	.....	797	.....	6,073	.....
Outfit	.....	207,840	.....	16,425	.....	22,028	.....	15,046	.....	34,800	.....	296,139
Vessels, transporting	38	114,355	14	26,130	14	22,500	71	149,100	6	3,850	143	315,935
Tonnage	571	.....	147	.....	218	.....	564	.....	39	.....	1,539	.....
Outfit	.....	22,550	.....	1,620	.....	1,590	.....	10,070	.....	440	.....	36,270
Boats	3,039	721,083	421	169,555	858	287,030	1,718	937,710	773	206,950	6,809	2,322,328
Apparatus:												
Vessel fisheries:												
Seines, trap nets, etc.	20	13,861	9	1,430	93	29,425	46	1,850	14	10,560	182	57,126
Lines	.....	2,217	.....	64	.....	776	.....	954	.....	542	.....	4,553
Dredges, tongs, etc.	10	298	.....	.....	268	4,562	33	679	31	338	342	5,877
Shore fisheries:												
Seines, trap nets, etc.	3,087	221,010	205	11,880	482	26,967	1,808	96,630	802	61,399	6,384	417,886
Dredges, tongs, etc.	295	49,682	387	3,206	480	4,760	521	3,777	349	3,235	2,032	64,660
Sponge apparatus	.....	35,540	.....	.....	.....	.....	.....	.....	.....	.....	.....	35,540
Shore and accessory property	.....	159,426	.....	7,625	.....	17,450	.....	60,780	.....	15,100	.....	260,381
Totals		2,271,738		295,420		676,573		1,385,696		567,114		5,196,541

FIGURE 10.—Baiting trawl lines, Red Snapper fishery—Campeche Banks. (Courtesy of Capt. F. W. Wallace.)

years they are usually as plentiful as before the occasion of such a disaster.

Until quite recently the taking of oysters was carried on in a very irregular manner, but with the increase in transport facilities and the influx of capital along the coast, the industry is rapidly developing into respectable proportions.

The oysters found on the coast of Texas are the same species as those occuring along the shores of the Atlantic Coast States, differing only as the oysters of one bay may from those of another in the immediate locality. The oysters of the several bays of Texas differ as much from each other as from those of the Atlantic Coast. In general the shells, while not like those of the "coon" oysters of some of the Southern States, are rather long and of very irregular formation. In many places the growth of oysters on a bed is several feet deep, forming ridges rising above the surrounding grounds. In such places, as well as on the muddy bottoms, they have a tendency to grow in clusters, often large enough to fill a bushel basket; this results in great irregularity in the contour of the shell. On account of this and the rank growth of the shell, caused by the abundance of lime brought down by the rivers, the yield of "solid meats" to the bushel is not as great as the average yield of the same grade of oysters on the Atlantic Coast. A "barrel" of Texas oysters "opens out" on an average not over 6 quarts, while in the Middle Atlantic States the same quantity would contain from 8 to 10 quarts of meats. The growth of the oysters is quite rapid; it requires about 550 "2½-year-olds" to fill a three-bushel barrel. In the Chesapeake region it requires fully 750 oysters of that age to equal this measurement. Texas oysters are found chiefly in the muddy sections of Madagorda and Mesquit Bays.

The quality of Texas oysters compares favorably with that of the Atlantic Coast. They are quite similar to the "Western Shores" of the Chesapeake Bay, or those obtained from the "Kettle Bottoms" in the Potomac River. In the spring, on account of the large quantities of fresh water that fill the bays, the oysters are frequently rather fresh, but they are nearly always fat. Except from November to March, the oysters in Texas spawn to a limited extent at all periods of the year, but more particularly during the first half of May.

These oysters are quite free from a number of enemies and adverse agencies common on the Atlantic Coast; starfish are not known, drills are not abundant, and an excellent set of oysters is secured nearly every year. But, the Texas oyster indus-

FISHERIES OF THE GULF STATES, 1923

Item	*Florida (West Coast)*		*Alabama*		*Mississippi*	
Products	Pounds	Value	Pounds	Value	Pounds	Value
Amberfish	13,845	$322	.....	.....	.....	.....
Angelfish	28,664	915	1,940	$72	.....	.....
Barracuda	1,600	64	.....	.....	.....	.....
Bluefish	417,840	39,025	3,500	210	5,900	$414
Blue runner or hardtail	351,968	16,176	1,200	36	.....	.....
Bonito	28,030	1,010	.....	.....	.....	.....
Catfish	114,780	5,313	16,220	638	35,440	1,278
Cero and kingfish	564,128	38,086	.....	.....	.....	.....
Crevalle	156,084	4,618	.....	.....	.....	.....
Croaker	.....	.....	36,600	1,115	45,015	1,881
Drum, black	95,294	2,878	9,250	279	38,989	1,263
Drum, red or redfish	1,398,291	43,249	14,765	949	176,760	12,979
Elops or ten-pounder	353,736	10,628	.....	.....	.....	.....
Flounders	71,315	3,936	2,190	178	87,616	8,919
Groupers	4,265,569	110,689	304,600	7,615	26,137	784
Grunts	94,867	2,846	2,975	73	.....	.....
Harvestfish or "butterfish"	1,000	45	.....	.....	.....	.....
Hogfish	9,448	284	.....	.....	.....	.....
Jewfish	109,188	2,565	.....	.....	5,200	156
King whiting	77,021	5,574	2,598	134	9,054	541
Leather jacket or "turbot"	1,450	53	.....	.....	.....	.....
Menhaden	10,955,825	78,303	.....	.....	400	20
Moonfish	775	22	.....	.....	.....	.....
Mullet, fresh	27,741,837	1,091,383	648,200	22,473	1,739,026	52,719
Mullet, salted	445,023	30,624	.....	.....	.....	.....
Mullet roe, fresh	13,945	1,653	.....	.....	.....	.....
Mullet roe, salted	20,765	1,836	.....	.....	.....	.....
Permit	8,493	266	.....	.....	.....	.....
Pigfish	6,156	179	.....	.....	.....	.....
Pinfish or sailor's choice	77,390	2,333	.....	.....	.....	.....
Pompano, fresh	280,403	51,446	770	159	7,156	1,462
Pompano, salted	1,000	100	.....	.....	.....	.....
Porgies	28,600	1,180	.....	.....	400	12
Porkfish	2,500	138	.....	.....	.....	.....
Sawfish	200,000	2,500	.....	.....	.....	.....
Sea Bass	25,100	2,450	.....	.....	7,940	595
Sergeantfish or snook	103,701	3,184	.....	.....	.....	.....
Sharks	3,000,000	24,000	.....	.....	.....	.....
Sheepshead	1,025,415	31,963	20,640	1,389	90,768	5,771
Snapper, mangrove	125,179	4,221	.....	.....	.....	.....
Snapper, mutton	28,225	1,013	.....	.....	.....	.....
Snapper, red	9,471,267	680,232	970,000	77,600	103,618	8,808
Spanish mackerel	3,772,028	308,829	1,185	119	10,082	966
Spot	55,929	1,677	15,760	486	27,245	912
Squeteagues or "sea trout"	1,590,523	157,169	48,910	4,903	410,294	37,327
Sturgeon	7,400	1,088	.....	.....	.....	.....
Sturgeon caviar	25	25	.....	.....	.....	.....
Tang	600	24	.....	.....	.....	.....
Yellowtail	38,672	2,422	.....	.....	.....	.....
Crabs, hard	.....	.....	84,000	2,750	434,644	11,431
Crabs, soft	.....	.....	.....	.....	8,800	2,180
Crabs, stone	7,200	1,200	.....	.....	.....	.....
Sea Crawfish or spiny lobster	321,010	16,051	.....	.....	.....	.....
Shrimp, green	2,881,454	114,509	3,182,000	119,239	9,879,100	359,086
Clams, hard	602,272	180,040	.....	.....	.....	.....
Conchs	2,500	50	.....	.....	.....	.....
Oysters, market, public	1,642,144	68,564	906,227	32,751	9,046,002	362,347
Oysters, market, private	.....	.....	725,375	53,968	2,828,952	110,305
Oysters, seed, public	.....	.....	630,000	13,500	.....	.....
Terrapin	.....	.....	2,332	933	7,200	3,585
Turtles	54,200	3,705	.....	.....	.....	.....
Sponges, grass	97,277	18,059	.....	.....	.....	.....
Sponges, sheepswool	339,623	778,949	.....	.....	.....	.....
Sponges, wire	16,028	7,479	.....	.....	.....	.....
Sponges, yellow	121,665	69,085	.....	.....	.....	.....
Total	73,266,267	4,026,227	7,631,237	341,569	25,031,738	985,741

try has its own troubles, the greatest being the destruction caused by heavy freshets in the spring. Another trouble which exists here to a considerable extent is the damage done by the drum fish. They are very numerous in all the bays along this coast, and they do much injury, especially where oysters have been taken from the reefs and bedded to wait a more favorable market. Occasionally an oysterman builds a

FISHERIES OF THE GULF STATES, 1923 (*Continued*)

Item	*Louisiana*		*Texas*		*Total of Gulf States*	
Products	Pounds	Value	Pounds	Value	Pounds	Value
Amberfish	.....	.....	.....	.....	13,845	$322
Angelfish	.....	.....	.....	.....	30,604	987
Barracuda	.....	.....	.....	.....	1,600	64
Bluefish	.....	.....	500	$85	427,740	39,734
Blue runner or hardtail	.....	.....	.....	.....	353,168	16,212
Bonito	.....	.....	.....	.....	28,030	1,010
Catfish	104,735	$3,931	50,340	2,614	321,515	13,774
Cero or kingfish	.....	.....	.....	.....	564,128	38,086
Crevalle	.....	.....	.....	.....	156,084	4,618
Croaker	219,025	12,554	67,970	3,288	368,610	18,838
Drum, black	59,988	2,000	1,028,451	36,807	1,231,972	43,227
Drum, red, or redfish	665,067	55,941	887,760	72,299	3,132,643	185,417
Elops or ten-pounder	.....	.....	.....	.....	353,736	10,628
Flounders	21,513	1,890	118,395	10,203	301,029	25,126
Groupers	10,000	500	32,725	980	4,639,031	120,568
Grunts	.....	.....	.....	.....	97,842	2,919
Harvestfish or "butterfish"	.....	.....	.....	.....	1,000	45
Hogfish	.....	.....	.....	.....	9,448	284
Jewfish	.....	.....	13,450	553	127,838	3,274
King whiting	.....	.....	11,403	1,015	100,076	7,264
Leather jacket or "turbot"	.....	.....	.....	.....	1,450	53
Menhaden	.....	.....	8,517,000	56,780	19,473,225	135,103
Moonfish	.....	.....	.....	.....	775	22
Mullet, fresh	181,485	6,152	7,543	274	30,318,091	1,173,001
Mullet, salted	.....	.....	.....	.....	445,023	30,624
Mullet roe, fresh	.....	.....	.....	.....	13,945	1,653
Mullet roe, salted	.....	.....	.....	.....	20,765	1,836
Permit	.....	.....	.....	.....	8,493	266
Pigfish	.....	.....	.....	.....	6,156	179
Pinfish or sailor's choice	.....	.....	.....	.....	77,390	2,333
Pompano, fresh	1,220	218	2,530	287	292,079	53,572
Pompano, salted	.....	.....	.....	.....	1,000	100
Porgies	.....	.....	.....	.....	29,000	1,192
Porkfish	.....	.....	.....	.....	2,500	138
Sawfish	.....	.....	.....	.....	200,000	2,500
Sea Bass	1,870	150	.....	.....	34,910	3,195
Sea gar, fresh	.....	.....	26,150	2,092	26,150	2,092
Sea gar, dried	1,150	92	.....	.....	1,150	92
Sergeantfish or snook	.....	.....	.....	.....	103,701	3,184
Sharks	.....	.....	.....	.....	3,000,000	24,000
Sheepshead	193,344	14,435	140,610	8,117	1,470,777	61,675
Snapper, mangrove	.....	.....	.....	.....	125,179	4,221
Snapper, mutton	.....	.....	.....	.....	28,225	1,013
Snapper, red	175,000	17,500	1,008,960	80,717	11,728,845	864,857
Spanish mackerel	2,600	361	78,920	8,200	3,864,815	318,475
Spot	23,435	829	.....	.....	122,369	3,904
Squeteagues or "sea trout"	783,214	73,031	1,523,965	154,238	4,356,906	426,668
Sturgeon	.....	.....	.....	.....	7,400	1,088
Sturgeon caviar	.....	.....	.....	.....	25	25
Tang	.....	.....	.....	.....	600	24
Yellowtail	2,500	72	.....	.....	41,172	2,494
Crabs, hard	312,600	7,626	108,900	8,665	940,144	30,472
Crabs, soft	3,000	1,050	.....	.....	11,800	3,230
Crabs, stone	.....	.....	.....	.....	7,200	1,200
Sea crawfish or spiny lobster	.....	.....	.....	.....	321,010	16,051
Shrimp, green	24,471,868	900,785	3,421,638	158,519	43,836,060	1,652,138
Shrimp, dried	410,117	83,284	.....	.....	410,117	83,284
Clams, hard	.....	.....	.....	.....	602,272	180,040
Conchs	.....	.....	.....	.....	2,500	50
Oysters, market, public	1,272,285	151,462	2,498,846	174,576	15,365,504	789,700
Oysters, market, private	5,882,478	618,972	21,000	1,500	9,457,805	784,745
Oysters, seed, public	.....	.....	.....	.....	630,000	13,500
Squid	5,800	580	.....	.....	5,800	580
Terrapin	22,500	7,512	.....	.....	31,782	12,030
Turtles	8,650	173	2,550	204	65,400	4,082
Sponge grass	.....	.....	.....	.....	97,277	18,059
Sponges, sheepswool	.....	.....	.....	.....	339,623	778,949
Sponges, wire	.....	.....	.....	.....	16,028	7,479
Sponges, yellow	.....	.....	.....	.....	121,665	69,085
Total	34,835,194	1,961,100	19,559,606	782,013	160,324,042	8,096,650

picket fence around his bedded oysters to prevent damage from this source, but this practice is not general.

Many of the well-known oyster reefs in Texas have not been fished on for several years, and some have

never been extensively resorted to, because other grounds are more conveniently situated from which the oystermen have been able to obtain a supply; and it is highly probable that there are large areas of oyster reefs within the bays along the coast of which the fishermen have no knowledge. No search for them has been made; the finding of the beds is in most instances due to the centerboard of a boat grating on the oysters when the boat is sailing over the bed. The average length of the shafts used in the tongs is only 10 feet, and the fishermen do not ordinarily attempt to obtain oysters at a depth greater than 8 feet; consequently they know little of the animal life on deeper ground.

MARKETING

At nearly all the fishing ports of Texas a number of men give their attention to the wholesale marketing of the products taken by the fishermen. The men have market houses located on the shores of the bays, from which piers 100 to 400 feet in length run out into the water. The products handled in these markets consists almost entirely of oysters and the catch made by the bay-seine fishermen, with at times a few flounders, catfish, turtles, and terrapin. The products of the other fisheries mostly find their way into local consumption without going through the wholesale markets.

All the fish are sent from the market houses while fresh, packed in boxes and barrels, and usually with two layers of fish and one layer of ice alternating. They are shipped mostly by express, and marketed throughout Texas, Mexico, New Mexico, Colorado, and Kansas.

The principal varieties of fish caught in Texas waters and which find a ready market are crevalle or jackfish, Spanish mackerel, striped mullet, bluefish, redfish or channel bass, pompano, rock or striped bass, red snapper, sheepshead, jewfish, drum, sea trout, croaker, hogfish or capitaine, and flounder.

COMMON AND SCIENTIFIC NAMES OF FISHES

In order to prevent misunderstanding from the use of common names employed in the tables and discussions, the following list of common and scientific names is given:

Amberfish	Seriola (species).
Angelfish	*Chætodipterus faber.*
Barracuda	Sphyræna (species).
Bluefish	*Pomatomus saltatrix.*
Blue runner or hardtail	*Caranx crysus.*
Bonito	*Sarda sarda.*
Catfish	*Felichthys marinus.* *Galeichthys felis.*
Cero and kingfish	*Scomberomorus regalis.* *Scomberomorus cavilla.*
Crevalle	Caranx (species).
Croaker	*Micropogon undulatus.*
Drum, black	*Pogonias cromis.*
Drum, red or redfish	*Sciæ nops ocellatus.*
Elops or ten-pounder	*Elops saurus.*
Flounders	Pleuronectidæ (species).
Groupers	Epinephelus (species). Mycteroperca (species). *Garrupta nigrita.*
Grunts	Hæ mulidæ (species).
Harvestfish or "butterfish"	*Peprilus alepidotus.*
Hogfish	*Lachnolaimus maximus.*
Jewfish	*Promicrops guttatus.*
King Whiting	Menticirrhus (species).
Leather jacket or "turbot"	*Balistes carolinensis.*
Menhaden	*Brevoortia tyrannus*
Moonfish	*Vomer setipinnis.*
Mullet	*Mugil cephalus.* *Mugil curema.*
Permit	*Trachinotus goodei.*
Pigfish	*Orthopristis chrysopterus.*
Pinfish or sailor's choice	*Lagodon rhomboides.* Other species.
Pompano	*Trachinotus carolinus.* Trachinotus (other species). (See also Permit).
Porgies	Calamus (species). Pargus (species).
Porkfish	*Anisotremus virginicus.*
Sawfish	Pristis (species).
Sea bass	*Centropristes striatus.*
Sea gar	Tylosurus (species).
Sergeant fish or snook	*Centropomus undecimalis.*
Sharks	All Selachii except Batoidei.
Sheepshead	*Archosargus probatocephalus.*
Snapper, mangrove	*Lutianus griseus.*
Snapper, mutton	*Lutianus analis.*
Snapper, red	*Lutianus blackfordi.*
Spanish mackerel	*Scomberomorus maculatus.*
Spot	*Leiostomus xanthurus.*
Squeteagues or "sea trout"	Cynoscion (species).
Sturgeon	*Acipenser sturio.*
Yang	Teuthididæ (species).
Yellowtail	*Ocyurus chrysurus.*

THE IRON AND STEEL INDUSTRY OF THE BIRMINGHAM, ALABAMA, DISTRICT

Langdon White
Economic Geographer, Randolph-Macon Women's College

AMERICA'S tremendous iron and steel industry is by no means centralized, for great plants are distributed in many districts throughout the Middle West, East, and South. In the latter region, the Birmingham District[1] stands supreme, for it enjoys the following unique advantages: (1) it literally sits astride of extensive deposits of coking coal, iron ore, and fluxing dolomite and limestone; (2) it has the cheapest labor supply in the United States; (3) it enjoys excellent transportation facilities, including a canalized waterway to the Gulf of Mexico, which offers freight rates via barge at 80 per cent of those by rail; (4) it has as its market approximately one-third of the country, both in area and in population; and (5) it makes the cheapest iron and steel in the United States.

Location and Topography of the Birmingham District

The Birmingham District lies in the Valley region of Alabama, at the southern edge of the Appalachian Mountains. Birmingham Valley, lying between 500 and 600 feet above tide, is an anticlinal valley, which is bounded by Shades Mountain on the east and by Sand Mountain on the west. In the valley is a chert ridge called Salem Hills near Bessemer, Flint Ridge north of Bessemer, and Cemetery Ridge at Birmingham.

This chert ridge separates two smaller valleys—Jones on the east and Opossum on the west. The former is bordered on the east by Red Mountain (Fig. 1), the source of practically all the red hematite used in Birmingham's blast furnaces, while the latter is bounded on the west by Sand Mountain. East of Red Mountain lies Shades Valley.

While to Birmingham's immediate tributary area, the valley is a valley, nevertheless in respect to the main drainage of the region, it is a watershed, since all the streams flow westward to the Black Warrior River (Fig. 1).

Through the several ridges just mentioned are numerous gaps, which are utilized by transportation lines for connecting the district with the rest of the country. Red Gap (Fig. 2), to the northeast, is the most important, for through it wind all five railroads which enter Birmingham from that direction.[2]

Evolution of Iron and Steel Making at Birmingham

Specific significant events—landmarks so to speak—characterize the development of every great industry in every outstanding area. In this district's evolution four events merit

[1] The Birmingham District—that iron and steel-making area at the southern end of the Great Valley—consists of the city of Birmingham and its satellite furnace towns of North Birmingham, Bessemer, Ensley, Fairfield, Oxmoor, Thomas, and Woodward (Fig. 1).

[2] Burchard, E. F., and Butts, C., "Iron Ores, Fuels, and Fluxes of the Birmingham District, Alabama," *United States Geological Survey, Bulletin 400* (Washington, 1910), pp. 11–12.

a passing word: (1) pig iron was first successfully manufactured at the old Oxmoor furnaces with coke as fuel in 1876; (2) the Pratt mines of coking coal were opened in 1879; (3) Open-Hearth steel was first made in 1899; and (4) a variety of iron and steel products is now made, which has brought great prosperity to the district.

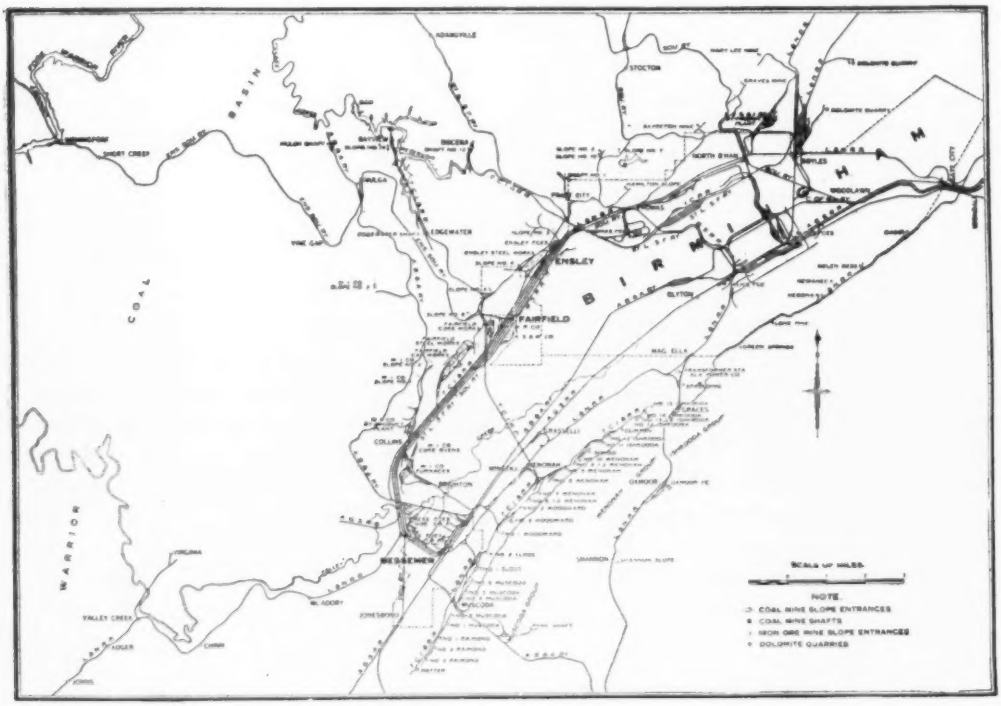

FIGURE 1.—The Birmingham, Alabama, District—one of the world's major iron and steel centers. Here the blast furnaces and steel mills lie in the heart of a natural storehouse of iron ore, coal, and dolomite, all in close proximity. Moreover, the plants and the mines and quarries are connected by an efficient transportation system. This district is the core of the South's rapidly growing iron and steel industry. (Courtesy of the Tennessee Coal, Iron and Railroad Company.)

BIRMINGHAM IN RELATION TO IRON ORE

Few industrial districts sit astride of their ore deposits, but this is literally true of Birmingham, which adjoins Red Mountain—the source of more than 86 per cent of the total iron ore tonnage of the district. Furthermore, it lies only 30 miles from Woodstock, the chief source of brown ore, and only 40 miles from the extensive and almost virgin deposits of gray ore in Talladega County.

PRODUCTION AND RESERVE

Nearly everyone who is alive to what is being done in the great iron and steel industry of our country, knows that the world's greatest iron mines occur in the Lake Superior Region, whence comes about 85 per cent of our total supply. But relatively few proportionally know that the Birmingham District ranks second in production, that it has reserves believed to be equal to those in the former region[3] (about 2,000,000,000 tons),[4] and that it gives

[3] Burchard, E. F., "Alabama Ores Equal Lake Supply," *The Iron Age*, March 24, 1927, p. 849.

[4] Burchard estimates a reserve of 1,470,000,000 gross tons of first-grade ore and 500,000,000 gross

promise of being our longest-lived iron mining district. Burchard estimated in 1924 that the ores in the Birmingham District should last 333 years at the present rate of production (about 6,000,000 gross tons per annum), whereas those in the Lake Superior Region should last but 33, since the annual production there is about 60,000,000 tons, or 10 times that at Birmingham. Furthermore, production in the Alabama region never could equal that in the Superior Region, because of the greater difficulty of mining; in the Mesabi Range, whence comes about two-thirds of the Lake Superior iron ore, gigantic steam shovels plunge their gaping jaws into the soft ore, grab from 2 to 5 tons at a single bite, and load a 50-ton car in less than 5 minutes; in the Birmingham District, mining, except in the case of brown ore, has to be carried on under ground (Fig. 3). This is costlier, slower, and more difficult.

tons of second-grade ore—a total of 1,970,000,000 gross tons above a depth of 3,500, or possibly 4,000, feet.

Red Hematite

Red hematite is the principal ore mined in the district, constituting approximately nine-tenths of the total output. It occurs chiefly in Red Mountain, which borders Birmingham Valley on the southeast. The Big Seam, which outcrops from Red Mountain, extends for more than 25 miles without a break, reaching its optimum development between Birmingham and Bessemer.

The Big Seam varies in thickness from 15 to 22 feet. Its ore averages from 30 to 40 per cent metallic iron as against 52 per cent for Mesabi ore, but since it lies relatively near the surface and is therefore comparatively easy to mine, since much of it (probably more than one-fourth of the actively mined ore) is self-fluxing, and since it lies so near the other raw materials and the blast furnaces, it does not suffer.

Practically all the red ore is mined by slopes (Fig. 4), since it occurs in beds that are quite uniform in dip and thickness. Slopes are usually

FIGURE 2.—Looking toward Birmingham through Red Gap—the gateway to the district from the East. The value of this gap as a magnet for transportation lines is indicated by the fact that it is used by the five routes entering the city from the East and North. (Photo by Charles Butts, United States Geological Survey.)

FIGURE 3.—Typical underground mining in one of the Muscoda iron mines in the upper bench of the Big Seam in Red Mountain. This is the face of a right-hand heading. The power drill is in operation, and the trammers and muckers are loading the ore. Note the negro miners; one-half of those of the state are colored. (Photo by the Tennessee Coal, Iron and Railroad Company.)

driven on the ore bed beginning with the outcrop, and are placed at intervals which average approximately 1,909 feet. Right and left headings are turned off at regular intervals of 50 to 65 feet.

"About 30 feet of ore is mined from the upper side of the heading and about 30 feet is left as a wall or pillar to protect the workings entry until robbery is begun. Mules haul the trams to the main slope, up which the ore is moved by a cable to a tipple, below which it is crushed and loaded directly into railroad cars bound for the furnace. A manway is usually provided at one side of the slope for the safe passage of men and mules."[5]

Brown Ore (Limonite)

Brown ore occurs in the southern portion of Birmingham Valley, especially near Woodstock, Champion, and Greeley, in irregular deposits or pockets in clay, gravel, loam, and sand. The deposits are so irregular and variable, however, that they have never been the basis of Birmingham's great industry. It is a common saying that "no one has much knowledge of a brown ore bank beyond the length of his pick." Furthermore, the future reserve is small, being estimated at only 15,000,000 gross tons. But its iron content is high, the ores carrying in carload lots from 39 to 50 per cent metallic iron. Therefore, it is well adapted to mixing with the red hematite, which carries an excess of flux.

The brown ore is mined economically and efficiently from open cuts by steam shovels, except where the bottom is irregular as in certain portions of the Woodstock area where there are projecting reefs and masses of underlying limestone. Moreover, because of mild winters, mining goes on throughout the year, which is in contrast to the situation in the Mesabi Range.

Since many impurities such as clay, gravel, loam, and sand are combined with this ore, it must be broken, washed, picked, and screened —operations which increase materially the cost of mining. But the ore thus treated contains 41 to 54 per cent metallic iron.

FIGURE 4.—Tipple and mouth of Slope No. 7 of the Tennessee Company's Alice Mine. The ore, brought by cable to the tipple, is crushed below. It is then loaded into cars and whisked away to the blast furnaces in the bottom of the valley. (Photo by Charles Butts, United States Geological Survey.)

[5] Burchard, E. F., and Butts, C., *op. cit.*, p. 135.

Gray Ore

This ore is found in veins, sometimes exceeding 15 feet in thickness, some 40 miles southeast of Birmingham in Talladega County. But, it has been only slightly worked, because of its high silica content and because of its greater distance from the blast furnaces than the red and brown ores. (In this district 25 miles is considered a long haul for ore.) If some method of concentration can be found for removing the silica, so high a concentrate would result that this ore could probably compete with the better located red hematite.

It is believed that the gray ore is just as good as the brown, and that it could be used just as advantageously for mixing with the lime-laden, self-fluxing red hematite.

BIRMINGHAM IN RELATION TO FUEL

Three coal fields—the Warrior, the Cahaba, and the Coosa (named from the rivers which drain them)—lie very close to Birmingham's blast furnaces, though the Warrior supplies all the fuel used for making coke. The Cahaba field (located east of Birmingham in a long narrow belt of steep dipping measures, which parallel the Cahaba River and embrace an area of about 325 square miles) contains coal that makes good coke, but since it holds a higher amount (about 10 per cent) of volatile matter, yields less, and makes costlier coke than coal from the Warrior field, it is not used. The small and little-worked Coosa field contains coal not adapted to coke-making. Thus, since all the fuel used in Birmingham's blast furnaces comes from the Warrior field, this paper will consider it alone.

The Warrior Field

This field, embracing the great sweep of some 3,500 square miles of coal-bearing lands west and northwest of Birmingham (Fig. 1), contains more than half the coal-bearing land of Alabama. For the most part the strata lie nearly flat (Fig. 5), though along "the southeastern margin they vary in dip along the outcrop from 15 to 80 degrees northwest." Normal faults, which extend at right angles southwest of Birmingham make mining quite difficult.

Most of the coke is made from the coal of two seams, the Mary Lee and the Pratt, the latter being to Birmingham what the Pittsburgh bed is to Pittsburgh (Fig. 6). The Pratt seam shows its best development just west of Birmingham where it outcrops in steep measures on the upturned east edge of the Warrior field (Fig. 5). It varies from 3 to 6 feet in thickness and includes small partings of bone, clay, shale, and sulphur. Of these impurities probably the sulphur is the most obnoxious, since it enters the iron and impairs its quality, though the others reduce its calorific power and so weaken it that it is unable to properly bear up the burden of the furnace. Accordingly, their elimination is imperative and is accomplished by washing.

The Mary Lee or "Big Seam" averages 5 to 7 feet in thickness as mined (slightly greater than the Pratt), but is dirtier and contains more partings of shale and clay. Moreover, considerable sulphur in the form of iron pyrite exists both in the coal and in some of the thin partings. All these impurities, which have so baneful an effect upon the coke, must be removed, as high-grade blast furnace fuel can be made only

from coal that is relatively low in both ash and sulphur.

Mining Practices

The outcrop of the Pratt seam is mined by slopes, while the flat coal to the west is mined by shafts. The room and pillar method is used almost exclusively. The workings follow the faces and butts of the coal, the mine entries and rooms being

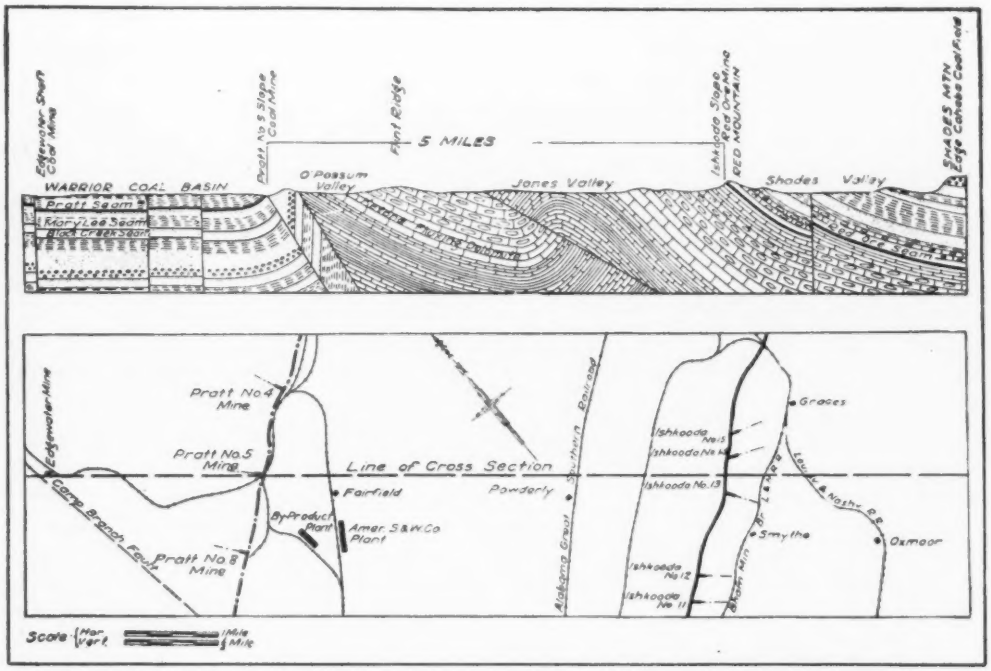

FIGURE 5.—This geological cross-section shows the juxtaposition of coal, dolomite, and iron ore in the Birmingham District. The rocks along the southeastern margin of the Warrior Coal Basin dip steeply to the northwest on their outcrop, but become practically horizontal about one-half mile from the outcrop. Coal mining in the interior of the field is carried on with comparative ease. Southwest of Birmingham, however, where faults have been encountered, mining is somewhat more difficult and costly. (Courtesy of the Tennessee Coal, Iron and Railroad Company.)

driven as nearly as possible in the direction of the face, and the side entries or cross headings approximately in the direction of the butts. There are many installations of electrical haulage and electrical undercutting.

Reserves of Coking Coal

Geologists estimate the quantity of coking coal in the Warrior field to be in excess of three and one-third billion tons which would more than suffice to reduce the available iron ore. If we assume that the coal will average 60 per cent coke (though it is now yielding 68.4 per cent), the 3,366,262,400 short tons of coal would yield 2,019,757,440 short tons of coke. But about one-third of the present output is used for domestic and steam purposes, and this will probably carry into the future. But even so, this would leave sufficient coal to make one and one-third billion tons of coke, or more than enough to reduce the one and one-half billion tons of ore. Even if there should be two billion tons of iron ore as estimated by Burchard, there would still be adequate fuel, providing the requisite proportion of coal were held in reserve for coking purposes only. Burchard has suggested that unless

the coal susceptible of coking is controlled or production curtailed there may be a dearth of fuel prior to the exhaustion of the ore reserves. However, there is the alternative of utilizing other beds outside the areas included in the above calculation.

Composition of Coking Coals

Warrior coal from the Pratt seam, while a good coking fuel, is nevertheless inferior in this respect to the celebrated Connellsville and Pocahontas coals. Table I indicates that Pratt coal is higher in volatile matter than Pocahontas but lower than Connellsville, and that it is higher in ash and sulphur than the other two.

TABLE I
AVERAGE ANALYSES OF CONNELLSVILLE, POCAHONTAS, AND PRATT COAL

	Connellsville [6]	*Pocahontas*[7] *and Tug River*	*Pratt*[8]
Moisture	1.260	2.26	2.41
Volatile matter	31.800	17.86	27.77
Fixed carbon	59.79	74.90	61.07
Ash	7.160	4.98	8.74
Sulphur	.530	.67	1.82

[6] Burchard, E. F., and Butts, C., *op. cit.*, p. 178.
[7] Coal and the Norfolk and Western Railway (Roanoke, Va., 1927), p. 6.
[8] Burchard, E. F., and Butts, C., *op. cit.*, p. 177.

BIRMINGHAM AND THE COKE INDUSTRY

Birmingham uses coke in its blast furnaces, because this fuel is hard and can therefore sustain the tremendous weight of the burden of the ore; it is porous and therefore permits the rapid combustion on which the heat of the furnace depends; and it is almost pure carbon and therefore burns with little ash.

Since coke is used exclusively, one naturally wonders how its price at Birmingham compares with that in other districts. Table II shows that the price in Alabama is considerably less than in any of the other states which have important iron and steel operations.[9] This is undoubtedly due to the city's proximity to the Warrior Coal Field.

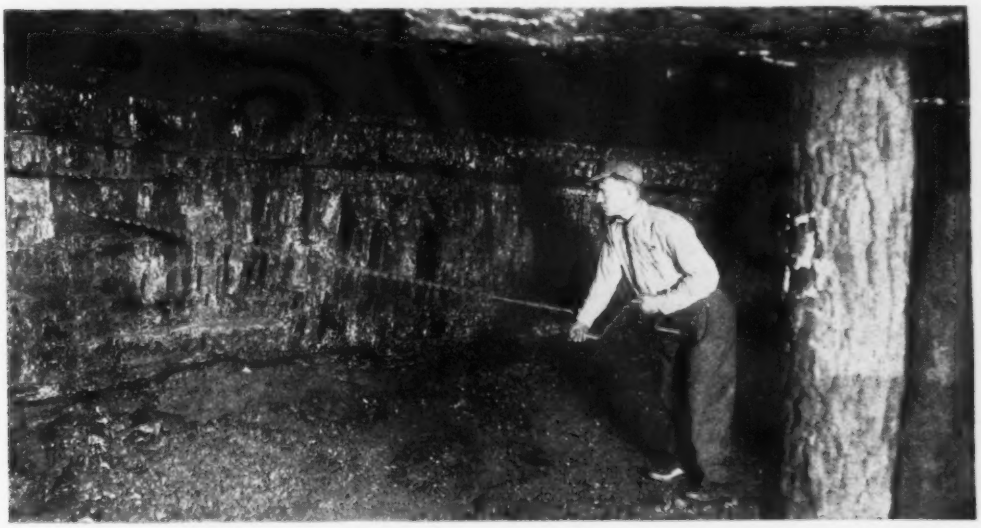

FIGURE 6.—The Edgewater Coal Mine shown in this photograph is one of the more important mines in the Pratt Seam. The coal is well adapted to coking. The miner is drilling preparatory to shooting. (Photo by the Tennessee Coal, Iron and Railroad Company.)

[9] The cost of fuel per metric ton of foundry and malleable iron in 1924 was only $5.42 at Birmingham, as compared with $8.34 at Buffalo, $6.38 in the Western District, and $8.32 in the Eastern District ("Iron in Pigs," United States Tariff Commission, 1927, p. 15).

TABLE II
COST OF COAL AND VALUE OF COKE PER TON IN CHIEF IRON- AND STEEL-PRODUCING STATES

State	Average Cost of Coal Per Ton Charged into By-Product Ovens	Value of Coke Per Ton at Ovens
Alabama	$2.95	$4.14
Illinois	5.78	9.53
Indiana	5.77	9.27
New York	5.31	7.18
Ohio	4.84	6.44
Pennsylvania	3.77	4.74

In 1923, Alabama made 4,654,075 net tons of coke.[10] Most of this was made in the Birmingham District, which has all but 97 of the state's by-product ovens. The bulk of this coke, 94 per cent, was made in by-product ovens, which have largely replaced the old bee-hive ovens, since they increase the yield of coke (68.4 *vs.* 57.9 per cent in 1923) and save the by-products, which are almost as valuable as the coke itself.[11]

Aside from the local market for the coke, Birmingham also absorbs the larger proportion of the by-products: it uses the ammonium sulphate in the manufacture of fertilizer; the heavy pitch from the coal tar for dipping cast iron pipe, and the surplus gas for boiler fuel or for domestic purposes.

The salient points regarding the by-product coke industry in this district are presented in Table III.

[10] Tryon, F. G., and Bennit, H. L., "Coke and By-Products in 1923," United States Geological Survey (Washington, 1926), p. 434.

[11] Only about 100 bee-hive ovens are now in operation. These are located at Bradford, a short distance north of Birmingham. Their *raison d'etre* is to supply those customers who will accept nothing but bee-hive coke.

BIRMINGHAM IN RELATION TO FLUXING MATERIAL

Fluxing stone, both dolomite and limestone, outcrops in this district, the former in belts paralleling the chert ridges of Opossum and Jones Valleys (page 349), and the latter along the west escarpment of Red Mountain, down the east side of Red Mountain from Canoe Creek almost to Trussville, along the west side of Birmingham Valley, and elsewhere (Fig. 7).

Only the dolomite, however, is utilized for fluxing; the limestone is used chiefly in the open-hearth furnaces at Ensley. The chief advantages of dolomite over limestone for fluxing in this district are (1) its fluxing power is greater; (2) it is purer; (3) it is of more uniform composition; (4) it gives greater fluidity to the slag, thereby enabling the furnaces to run smoother and more regular; and (5) it lowers the proportion of sulphur in the pig iron —a most important factor, inasmuch as basic iron is sold under severe restrictions.

TABLE III
BY-PRODUCT COKE PLANTS IN THE BIRMINGHAM DISTRICT, JANUARY 1, 1927

Name of Company	Location	Number of Ovens	Annual Capacity (Net Tons) Coal	Coke
Republic Iron and Steel Company	Thomas	57	720,500	504,350
Semet-Solvay Company	Ensley	240	760,000	530,000
Sloss-Sheffield Steel and Iron Company	Birmingham	120	864,000	622,000
Tennessee Coal, Iron and Railroad Company	Fairfield	497	3,217,000	2,251,900
Woodward Iron Company	Woodward	270	330,000	231,000
Alabama By-Product Coke Corporation	Birmingham	149	1,169,000	818,300
Total		1,333	7,060,500	4,957,550

BIRMINGHAM IN RELATION TO TRANSPORTATION

To succeed in the manufacture of iron and steel, a district must have excellent transportation facilities; the United States Tariff Commission goes so far as to say that "freight is

the controlling factor in the location of blast furnace plants, the appraisal of competitive power in different markets, and even in the location of some iron-consuming industries." [12] Every district must be able to assemble its basic raw materials at the blast furnaces without interruption, and ship its finished articles to market without delay. In both these respects, Birmingham is highly favored.

TRANSPORTATION BY RAIL

Relative to the cost of assembling its raw materials, Birmingham is the most favored district in the country.

FIGURE 7.—Dolomite quarry of the Republic Iron and Steel Company in Opossum Valley, Thomas, Alabama. The photograph shows the relief of the district and the method employed for raising the stone. Though the blast furnaces cannot be seen, they are nearby. (Photo by Charles Butts, United States Geological Survey.)

THE ASSEMBLY OF RAW MATERIALS

It has the dolomite in the bottom of the valley in close proximity to the furnaces, and the iron ore and coal higher up on the slope, on opposite sides of the valley, but all within 15 miles of one another.

Moreover, because of the simple relief of the region, the minerals and stone are workable over a wide area, the region being literally peppered with mines (Fig. 1). And wherever the mines are being worked, railroads are serving them—delivering their precious output to the coke ovens and furnaces in the valley bottom. The railroads thread their way from valley to valley, utilizing as passageways some 10 gaps, which cut at right angles through the ridges (Fig. 2). The important part played by the railroads in the development of the Birmingham District's mining and manufacturing industries cannot be too strongly emphasized.

More transportation lines enter Birmingham than any other southern city. The trunk lines entering the district are the Alabama Great Southern; the Atlanta, Birmingham, and Atlantic; the Central of Georgia; the Illinois Central; the Louisville and Nashville; the Seaboard Air Line; the Southern; and the St. Louis and San Francisco. Then, there are several district lines—the Birmingham Southern, the Ensley Southern, and the Birmingham Belt Line. The latter encircles the entire city, making connections with the chief manu-

[12] "Iron in Pigs," United States Tariff Commission (Washington, 1927), p. 20.

facturing plants and with each of the trunk lines.

Several of the companies operate their own railroads for plant switching and for hauling raw materials from the mines. Probably the best is that of the Tennessee Coal, Iron, and Railroad Company, whose tracks tap 22 mines, 11 each of coal and iron. It handles from 275,000 to 350,000 tons of coal, and about 250,000 tons of iron ore per month.[13]

In order to expedite its handling of red ore, this company recently constructed a standard gauge railway known as "High Line," connecting the mine tracks on Red Mountain with the industrial tracks serving the blast furnaces. This line extends for about five miles from Fairfield directly across Jones and Opossum Valleys and through Flint Ridge to the Wenonah Mines, where it connects with the Ishkooda and Muscoda groups (Fig. 1). The significance of gravity's aid in the assemblage of raw materials, especially heavy iron ore, in this district, cannot be over-emphasized.

THE DISTRIBUTION OF MANUFACTURED PRODUCTS

Birmingham is just as fortunately located for distributing its manufactured iron and steel products as it is for assembling its raw materials. It has easy access by the many railroads to all parts of the country via the gaps that permeate the surrounding ridges.

TRANSPORTATION BY RIVER

Transportation costs are vital in nearly all industries, but especially so in those like the iron and steel industry, which make heavy commodities in proportion to their value. These costs ordinarily determine a steel user's market. Accordingly, the saving of about 20 per cent afforded Birmingham manufacturers by the Federal Barge Line supplements considerably the district's many other advantages.

As a matter of fact Birmingham is not on the Black Warrior River (Fig. 1), but is about 26 miles east of it. However, this is immaterial because the Ensley Southern Railroad, which connects Birmingham with its port, Birmingport, is now a part of the Mississippi-Warrior Service and "this has the effect, so far as freight rates are concerned of shifting the channel of the Black Warrior River right through the heart of Birmingham." [14]

The distance from Birmingport to Mobile by barge is 419 miles. Locks and dams have been constructed by the Government at a cost of $10,315,095 along the lower courses of the rivers and maintain a draft of 7 feet throughout the year.

That much is expected of this waterway is evidenced by the construction of new terminal facilities at several places along the route. For instance, Mobile, Birmingham's seaport, is spending $10,000,000 improving its harbor. It is giving careful consideration to every aspect of transferring freight from rail to vessel. Mobile is one of the most highly favored ports on the Gulf: it is a land-locked, fresh water harbor, which affords protection from storms and barnacles; it has good depth, 30 feet; it is the cheapest coaling station on the Gulf, because of its proximity

[13] "Mining and Steel-Making Methods in Alabama," *Tennessee Coal, Iron, and Railroad Company* (Birmingham, 1924), p. 51.

[14] Clark, N. M., "Birmingham—The Next Capital of the Steel Age," *The World's Work*, March, 1927, p. 539.

to the great coalfields of the Birmingham District and the cheap water transportation afforded by the Federal Barge Line, and it is commodious.

At the present time (1927) the Government is operating on the river 55 steel barges, the equivalent of 60 barges each of 500 tons capacity, and 3 steel tow boats. But this is inadequate; during the past year the Service could handle only about 80 per cent of the tonnage offered it by the Tennessee Coal, Iron and Railroad Company. In 1926 it transported 85,368 tons of iron and steel products.[15]

BIRMINGHAM IN RELATION TO MARKETS

A national authority on the scientific location of industries says that the ideal location for a manufacturing plant is at a point where raw materials and markets for the finished products are both available, but that the situation is seldom, if ever, realized.[16] However, Birmingham's iron and steel mills benefit from just such a location, and more too, for they get in addition the cheapest labor in the United States.

The unique significance attached to Birmingham's juxtaposition of iron ore, fuel, and flux has been discussed. The invaluable significance of its proximity to market, today considered by many as being the most important single factor influencing the location of a steel district, will now be treated.

Local Market

Birmingham's chief market is the city itself, which absorbs about 86 per cent of its pig iron and about 50 per cent of its steel. Several decades ago, the district marketed the bulk of its pig iron north of the Ohio River and along the Atlantic Seaboard, but it has lost a large part of this trade on account of increased transportation costs. Consequently it developed home industries, chief of which is the manufacture of iron pipe. Of America's total tonnage of cast iron pipe in 1924—about 1,000,000 tons—Alabama produced 400,000 tons or 40 per cent, valued at about $21,000,000. Birmingham makes water pressure pipe, while Anniston, to the east, specializes on sanitary and soil pipe.

This home market also utilizes a tremendous amount of iron and steel for the manufacture of products which are used near home—sugar mill machinery, cotton gins, mining machinery, cotton ties and hoops, coal washing machinery, stoves and ranges, and cars.

Were it not for this local market, Birmingham's industry would be in a precarious condition indeed, for it could operate successfully only during periods of exceeding prosperity, when price is a secondary matter. Fortunately, this market belongs to Birmingham alone; it cannot be invaded by northern competitors, who face high freight rates and make pig iron at higher cost.

American Market Outside Birmingham

In its relation to the rapidly growing markets of the South, Birmingham occupies a position not unlike that of Chicago to those of the

[15] The barges at the disposal of the Birmingham manufacturers are inferior to those being used in the trade between Pittsburgh and lower Ohio and Mississippi River points. There can be little doubt that if the Tennessee Coal, Iron and Railroad Company should build and operate barges that would be comparable with those of the Jones and Laughlin Steel Corporation and the Carnegie Steel Company at Pittsburgh, it could deliver its products to the Gulf for a fraction of the present cost.

[16] Colburn, H. S., "Reducing Freight by Plant Location," *Manufacturing Industries*, June, 1927, p. 437.

North. This district can compete successfully with Chicago and Pittsburgh in approximately one-third of the area of the United States, where dwell about one-third of our people (Fig. 8).

Owing to its location at the southern end of the Appalachians, where the salient characteristics of these mountains are rapidly fading, and where numerous gaps cut through the ridges, Birmingham has easy access to all parts of the country. Moreover, it enjoys the advantages of year-long water transportation to the Gulf. Thus Birmingham can distribute its products quickly and efficiently throughout the entire South.

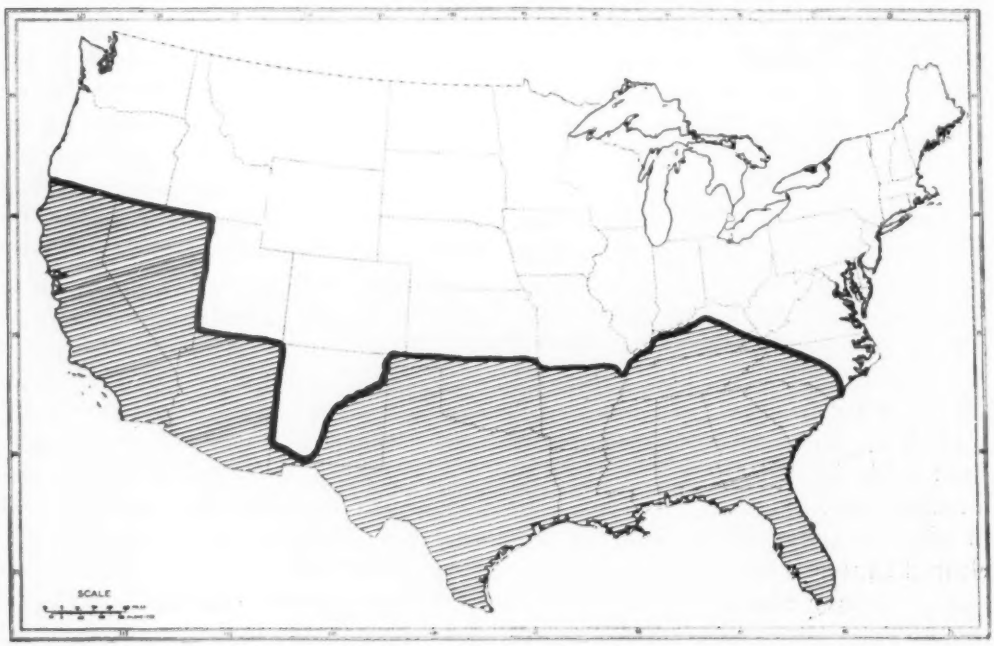

FIGURE 8.—The shaded portion of the map indicates approximately that portion of the United States where the rates from Birmingham meet or equal those from Pittsburgh and Chicago on bars, plates, sheets, and structural steel. It comprises about one-third of the country's area and contains about one-third of its population. (Drawn on Goode's Projection, No. 10.)

Foreign Market

Considering Birmingham's advantages for assembling its raw materials at the blast furnaces and for distributing its finished products to seaports, it is probably the best located iron and steel district in the country for carrying on foreign trade, especially with Latin America and the Orient. It has been aptly stated that one of the chief reasons why the United States Steel Corporation decided to build a great unit at Birmingham was because of its convenience for distributing its products to Latin America.

Yet Birmingham's foreign trade is small. During the 10-year period, 1914–1924, the Tennessee Coal, Iron and Railroad Company, the district's largest steel producer, exported only 1,659,257 net tons of steel products. However, it could have exported more had more goods been available, but Birmingham is sagaciously supplying its home market first. "Export markets may be cut off at any

time by customs tariffs or the rate and service hazards of distance," but the home market is secure.

BIRMINGHAM IN RELATION TO THE COST AND SUPPLY OF LABOR

When every district is striving to cut down its production costs as is the case in the United States today, every favorable condition is significant. Thus cheap labor, while less important in the iron and steel industry than in some others, is important. In 1923 labor made up about 7 per cent of the cost of a gross ton of pig iron, whereas it made up about 87 per cent of the total cost of cotton.

A report of the Bureau of Labor Statistics shows that the average hourly earnings of Birmingham's iron and steel workers in all departments are appreciably less than in other districts. This is probably consequent upon the importance of common labor, for despite the fact that skilled workers in all districts receive about the same wages, the preponderance of common labor pulls the total to a low figure (Table IV).[17] An exceptionally large amount of unskilled labor is used here because three of the four operators make pig iron exclusively. Wages are less in this district, because living costs, especially clothing, fuel, and rentals, are appreciably less than in the colder climates of the North.

Questions that naturally arise at this point are: Is the labor here efficient? Is the Birmingham negro the equal of the Pittsburgh or Chicago white? Does not the hot humid climate make for inefficiency? Having observed iron workers performing their tasks in all of America's major iron-making districts, the writer feels that Birmingham's workers are by no means inferior. They are cheerful, conscientious, industrious, and tractable. Mr. George G. Crawford, President of the Tennessee Coal, Iron and Railroad Company, says, "The population of the Southern States is approximately 75 per cent white and 25 per cent negroes, both easily trained and efficient in manufacturing when trained. It is found that this population turns eagerly to manufacturing when afforded the opportunity, in order to procure a higher standard of living than has hitherto been possible in agricultural pursuits. If manufacturing becomes proportionately balanced with agriculture, the profits of agriculture will increase, due to the operation of the law of supply and demand. The South is today the greatest, best, and cheapest labor market in the United States." [18]

TABLE IV

AVERAGE HOURLY EARNINGS IN EACH DEPARTMENT, ALL OCCUPATIONS COMBINED, 1926, BY DISTRICT

District	Blast Furnaces	Bessemer Converters	Open-Hearth Furnaces	Puddling Mills	Blooming Mills	Plate Mills	Standard Rail Mills	Bar Mills	Sheet Mills	Tin-plate Mills
Eastern	$0.475	.....	$0.627	.....	$0.589	$0.448	.....	$0.536	.....	.....
Pittsburgh	.567	$0.654	.690	.....	.640	.683	.....	.638	$0.768	$0.718
Great Lakes and Middle West	.592	.624	.725	.....	.666	.668	.....	.636	.748	.674
Southern	.374	.....	.542	.....	.521	.....	.....	.424	.....	.....
All districts	$0.517	$0.641	$0.677	$0.657	$0.627	$0.606	$0.595	$0.591	$0.759	$0.704

[17] From *Wages and Hours of Labor in the Iron and Steel Industry, 1907 to 1926, Bulletin No. 442*, Bureau of Labor Statistics (Washington), 1927, p. 13.

[18] Crawford, G. G., "The South's Part in American Exports." Address delivered at the Thirteenth National Foreign Trade Convention, Charleston, S. C., April 28, 29, 30, 1926. Reprint, p. 5.

BIRMINGHAM IN RELATION TO INDUSTRIAL WATER

In relation to its water supply, Birmingham differs from its chief rivals—Pittsburgh, Chicago, Youngstown, Buffalo, Cleveland, and Bethlehem; whereas their plants all adjoin rivers or lakes, Birmingham's adjoin neither, since neither is available.

Does this mean then that Birmingham is handicapped in this one resource—the only respect in which we have found its location unfavorable? It did mean that at first, but it does no longer, for man's ingenuity triumphed. Miss Armes in her "Story of Coal and Iron in Alabama" states that the industrial water supply "has ever been the one lack of the Birmingham District for manufacturing enterprises on a modern scale. From the very time the old Pratt mines opened, way back in the '70's, the need has been felt."

But a study of all feasible methods of obtaining water was made and a solution reached. One official of a large company stated to the writer that he believed the Tennessee Company, at least, had a better water supply than Pittsburgh.

Since the Tennessee Company is the district's largest and the only one to make much steel (steel plants require greater quantities of water than blast furnaces owing to their more diversified activities), an account of its water supply will illustrate the situation in the district.

There is a pumping station, the Central Water Works, at Edgewater (Fig. 1) with a total pumping capacity of 84,000,000 gallons per 24 hours. From the pumps the water is sent through a tunnel more than a mile long to a high-level reservoir near Wylam with a capacity of 17,000,000 gallons. From here the water flows by gravity to the great plants at Ensley and Fairfield, where, after being chemically treated, it is used for cooling purposes and for generating steam.[19]

Moreover, an impounding reservoir covering about 350 acres with a capacity estimated at from three to five billion gallons has been built by this company near Bayview (Fig. 1). It accumulates the run-off from an area of about 75 square miles.

One or two of the furnaces, e.g., the Sloss-Sheffield City Furnace, get their supply from the Birmingham Water Works, which obtains it from the Cahaba River and Five Mile Creek. The companies at Thomas and Woodward have their own systems. Thus, we see that this district labors under no marked handicap relative to its supply of industrial water.

BIRMINGHAM IN RELATION TO LEVEL LAND

Great tracts of land, preferably level land, are imperative to the proper development of an iron and steel district, because all the processes of manufacture are confined to single-story buildings. While each department is an entity in itself, yet there must be a coördination in order to produce the finished product. Thus, cramped conditions are highly undesirable. The larger the site, the greater is the opportunity for expansion and efficiency.

Pittsburgh is an excellent example of a city with no more room either for the expansion of old plants or for the erection of new ones. Any additions to the Pittsburgh District must be in the city's satellite towns.

[19] "Mining and Steel-Making Methods in Alabama," *op. cit.*, p. 49.

Birmingham, on the other hand, is an excellent example of a district with plenty of room. It has no land problem now nor will it have one in the future.

THE MANUFACTURE OF PIG IRON AT BIRMINGHAM

Just as Pittsburgh has specialized in the manufacture of steel, so Birmingham has specialized in the manufacture of pig iron. And just as Pittsburgh has become synonymous with "steel," just so has Birmingham become synonymous with "pig iron."

Several decades ago Birmingham made and sold pig iron so cheaply that she made the whole world stand aghast. Then she marketed practically all her iron north of the Ohio River and along the Eastern Seaboard; now, however, she consumes the bulk of it at home, for greatly increased transportation costs, plus higher labor and mining costs, have made it impossible to supply such distant markets at a profit.

Four companies operate in this district—The Republic Steel and Iron Company, The Sloss-Sheffield Steel and Iron Company, the Woodward Iron Company, and the Tennessee Coal, Iron and Railroad Company. These concerns in 1925 made 2,453,821 gross tons of pig iron—about 87 per cent of Alabama's and about 7 per cent of the country's total. The first three companies supply the greater part of the pig iron used by the South, while the latter specializes in the manufacture of basic iron for steel-making.

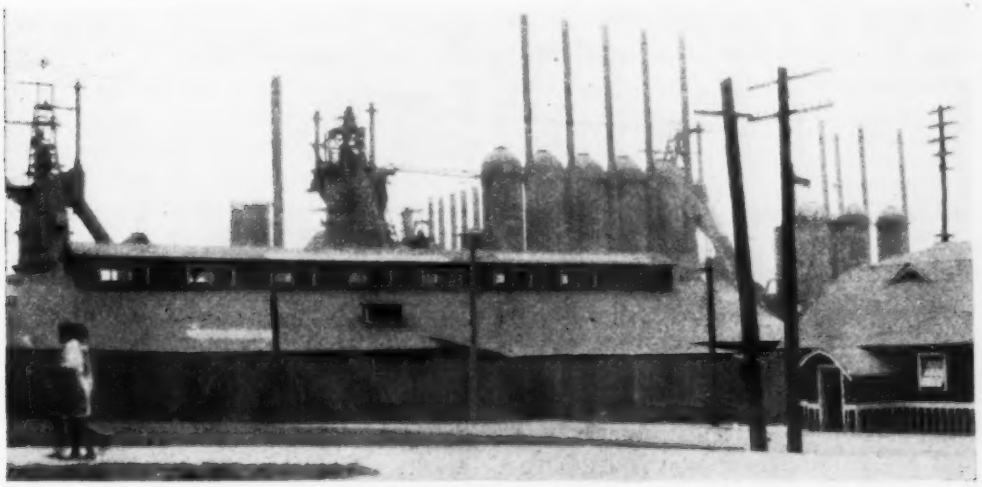

FIGURE 9.—Blast furnaces at Woodward (the two on the left). Blast furnaces are built to "rob the ore of its oxygen, flux out the impurities, and leave the iron."

GEOGRAPHIC ASPECTS OF IRON-MAKING

Since the iron in the iron ores is mixed with numerous earthy materials, it must be separated from them by smelting. This is accomplished in a blast furnace (Fig. 9), which is a gigantic oval-shaped structure into whose top are dumped almost unbelievable quantities of iron ore, coke, and flux. The molten liquid iron, being very heavy, sinks to the bottom of the furnace and is drawn off at regular intervals of six hours, and

either cast into pigs[20] or converted immediately into steel.

Since such tremendous tonnages of these raw materials must be fed to the blast furnaces day and night (they run continuously), the chief geographic consideration is the cost of their assembly. The closer they lie to the furnaces, the more economically can they be assembled, and the cheaper becomes the cost of making pig iron. Inasmuch as the iron ore, coal, and dolomite all lie within 15 miles of one another and of the furnaces, a juxtaposition found nowhere else in America, Birmingham's assembling and manufacturing costs are the lowest in the country.

MANUFACTURE OF STEEL AT BIRMINGHAM

The steel industry at Birmingham is comparatively new, the first Open-Hearth steel having been made less than three decades ago. Until 1907, when the ever-failing Tennessee Coal, Iron and Railroad Company became a subsidiary of the United States Steel Corporation, the industry was in a precarious condition indeed, for the company had insufficient capital and used impracticable methods. But the Steel Corporation, with its tremendous resources, has changed all this, and Birmingham is today the peer of all the South in the manufacture of steel, its production having increased 243 per cent in the decade 1914 to 1924. In 1925 it made about 1,400,000 tons of steel.

At Ensley the duplex process is used for converting Birmingham's highly phosphoric red ore into steel. This process is a combination of the acid Bessemer and the basic Open Hearth. It functions either with or without scrap.

FIGURE 10.—No iron and steel district in the country is so scientifically located as the one at Birmingham. In the North, Appalachian coal and Lake Superior iron ore are separated by more than 1,000 miles, and the limestone is located with neither. In the Birmingham District all three of these materials lie within 15 miles of each other. This enables one to understand why Birmingham makes cheaper iron and steel than Pittsburgh and Chicago. (Courtesy of the Tennessee Coal, Iron and Railroad Company.)

While the Bessemer converters used here carry on the usual Bessemer performances, e.g., eliminating partially or wholly the silicon, manganese, and carbon, which is accomplished by the oxygen in the blast, they are in reality auxiliaries to the open-hearth furnaces. The latter eliminate the phosphorus and make steel in about six hours.

GEOGRAPHIC ASPECTS OF STEEL MAKING

Geography does not enter into the actual manufacture of steel, but it plays a very important rôle in the

[20] Pig iron is made both in sand moulds and in pig-casting machines. A tremendous amount of the sand-cast product is made in this district.

location of the mills. Steel is made most economically when the mills either adjoin or are near the blast furnaces, for then they may use *hot metal*, thus obviating the re-heating of pigs.

In this district the steel mills are scientifically located. The new plant at Fairfield, including a blooming, a combination sheet and bar, and a plate mill, uses hot ingots from the Ensley steel works, only a short distance away (Fig. 1). At the same point, another subsidiary of the United States Steel Corporation, the American Steel and Wire Company, recently erected a complete wire mill, utilizing billets from the other plant and making practically all kinds of wire and nails. Birmingham teaches well the lesson of integrated and complementary manufactures.

PROBABLE FUTURE OF BIRMINGHAM DISTRICT

Although prophesying is undeniably hazardous, the writer feels that the unique combination of favorable geographic and economic conditions for iron-making at Birmingham warrants an optimistic forecast of its future. Certainly no other American iron and steel district is so scientifically located (Fig. 10). Straddling its iron ore, coal, and dolomite; commanding the cheapest supply of labor in the United States; having access to the Gulf via a canalized waterway, which offers rates at 80 per cent of those by rail; marketing 86 per cent of its pig iron and 50 per cent of its steel within the district itself, and making the cheapest pig iron in the country, it would appear that Birmingham might expand limitlessly so long as she can market her products at a profit. Accordingly, it is little wonder that many students of the industry look to Birmingham, rather than to Pittsburgh or Chicago (both of which must always have an enormous home demand to supply), as the ultimate development of the United States Steel Corporation.[21]

[21] *Iron Trade Review*, Vol. 78, Jan. 7, 1926, p. 48.

AMERICA'S RESOURCES IN NITROGEN, POTASH AND PHOSPHORUS

Guy Elliott Mitchell
United States Geological Survey

PRESIDENT ROOSEVELT performed few greater services to the country than when in 1908 he called together a Conservation Congress in the United States and set in motion the multiform governmental machinery of State and Nation to examine into the extent and condition of our natural resources. In the majority of these natural resources, as the coincident national inventory showed, the United States was possessed of very great wealth. In our reserves of many of the useful minerals we were disclosed as a storehouse full to overflowing and preëminent among all the nations. Many of our mineral deposits were found to be so great as to be classed as almost, if not actually, inexhaustible. There were a few, however, in which America was plainly deficient, and among them were three of transcendent importance to the future prosperity of the nation, although none of these three had been very generally recognized as perhaps anything more than desirable, certainly not as prime necessities. These were the three elements of plant food, upon which the future of American agriculture absolutely depended—nitrogen, phosphorus, and potash. A generation ago the people of the United States were in almost total ignorance of the function of these three elements, and even today the average citizen, the man on the street in the city, has but slight conception of their importance to the public and to himself personally.

Agriculture, it is a trite saying, is the backbone of America. Yet, we are prone to discuss the ups and downs of agriculture as being purely a farmer's problem, and even to attempt to remedy existing farm troubles by national legislation. If prosperous agriculture is vital to the health of the nation, the question of maximum production from the soil is one of its primary factors. And, maximum yields cannot be attained with the present constantly decreasing soil fertility. The lessening production per acre of the farms of the United States is a matter which should be of no little concern to everybody whether he lives on a farm or in the top story of a sky-scraping apartment house.

The settlers of America found a vast domain of mostly fertile soil, hundreds of millions of acres of it. Used, in their native lands, to conserve and re-use every bit of fertilizing material, they soon forgot the habits of a lifetime and found it easier to exhaust the fertility of their newly settled lands and then move on to another location among the apparently illimitable areas to the westward. Why struggle to maintain the fertility of the old farm when just beyond was a boundless empire of rich virgin soil? And so, it has been paraphrased, "Westward the course of empire takes its way, and leaves the ruined lands behind."

The pioneers have years since reached their outmost Western barrier—the broad Pacific—and now it

is time to take account of these ruined lands behind and consider the problem of rehabilitating and rejuvenating them and of staying the process of depletion with other lands whose fertility has not yet been reduced to the point of their abandonment.

The first question that may naturally arise is, "Why should there be such a sudden reduction in soil fertility on American farms? Many soils have been farmed for hundreds, indeed thousands, of years and have maintained their fertility. Why, then, this present urge for increasing or bringing back the soil's fertility and the need for concentrated fertilizers; why the excitement following a recent American discovery of beds of potash salts?

FIGURE 1.—Rock phosphate from Florida quarries ground ready for sacking and distribution to agricultural lands needing fertilizer. Much is exported to Europe.

The answer has a two-fold aspect. In the earlier generations practically everything that was raised on the farm was used on and went back into the farm; now our farmers are, without exception, exporters. Every bushel of wheat, for example, draws from the soil a certain proportion of its limited stock of plant foods and whether the wheat goes to Europe or to the nearest city, the plant food it contains is lost forever to the soil that grew it. Thus, millions of tons of concentrated mineral plant food are annually shipped away from the farm and but little equivalent is returned. Obviously this cannot endure indefinitely. Another phase of the trouble lies in our American habit of waste. The Department of Agriculture recently made some careful estimates of the value of farm manure annually produced and former Assistant Secretary Carl Vrooman placed the figure at $2,450,000,000, adding that one-half, if not more, of it was wasted and lost, constituting a real factor in the cost of farm and garden produce, and indicating a typical American waste. Most of this great lost resource would be saved if American farmers were, for instance, Dutch or German farmers. It would be saved by the farmers of any of the Old World countries where

every pound of soil fertility is conserved as automatically and as naturally as though it were minted money. Waste due to leaching, heating, and evaporation accounts for this vast loss. As showing that this estimate of a 50 per cent loss of our national manure pile is conservative, the citation of a single experiment by the Cornell Experiment Station will indicate that there are different kinds of manures. This test showed that two tons of horse manure exposed in a pile for five months—a very common farm practice—lost the surprising amount of 57 per cent of its gross weight, 60 per cent of its nitrogen, 47 per cent of its phosphoric acid, and 76 per cent of its potash. But even should we overnight become manure conservationists, there would still be the huge loss in soil fertility through the wholesale exportation of farm products, the only remedy for which can be through the application of concentrated fertilizers.

Plant growth, production, and reproduction is a wonderful process. That the very same soil should produce a tender, edible leaf and next to it a hard, bone-like shell enclosing a nourishing, meaty nut, is as wonderful as anything in Nature. And while our great range of edible products of the soil contains scores of different minerals and other properties, there are just three real essentials to plant growth—nitrogen, phosphorus, and potash—the trinity of agriculture. To maintain in the United States any sort of agricultural adequacy for our own population, to

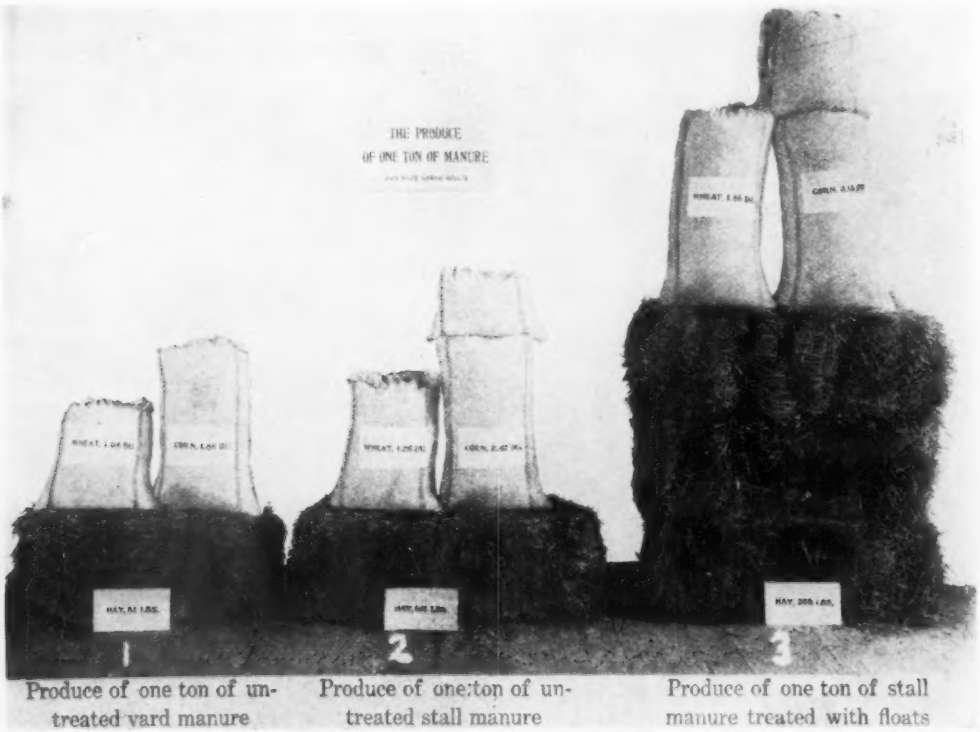

FIGURE 2.—A self-explanatory chart, illustrating the noteworthy increase in yields resulting from the application of raw rock phosphate, or "floats" mixed with manure; a seven-year average on plots at the Ohio Agricultural Experiment Station.

FIGURE 3.—The effect of fertilizer. In Box 1 the soil has been enriched with nitrogen, phosphorus and potash; in Box 2 with nitrogen and potash; in Box 3 with nitrogen and phosphorus; and in Box 4 with none.

say nothing of world supremacy, we must have enormous supplies in concentrated form of all three of these elements. Each of this farm trinity is quite as essential to life as is the oxygen in the air we breathe. Each one is necessary in all soils, and without it there would be no plant growth whatever and consequently no animal life on the globe. In the morning you eat with a good appetite your cereal and your bacon and eggs and drink with relish your cup of coffee, while your heartier meal at night is perhaps a thick slice of roast beef, with vegetables, good wheaten bread, and a toothsome salad. Where did they all come from—meat, bread, vegetables, fruit? From the soil. Without nitrogen in that soil not one of them could have been produced; without phosphorus not one of them could have been produced, and without potash, not one. Any skeptic can easily demonstrate, by a simple experiment with four pots of clean sand and a packet of garden seed, the necessity for all three elements. The sand itself will little more than sprout the seeds—tomato seeds would be good for the experiment—since sand is devoid of plant food and as soon as the substance in the seed itself is exhausted the plant will die. Nitrogen and potash added to the sand in one of the pots will produce only a tiny, weak tomato plant which will die soon. Nitrogen and phosphorus in the second pot will do no better, nor will phosphorus and potash in the third pot make the plant grow. But, now mix with the sand in a 10-inch flower pot adequate proportions of all three elements—nitrogen, potash, and phosphorus—and you may have a luxuriant tomato plant that will blossom and perfect its fruit. Or, when your nitrogen-potash plant, after putting out perhaps a sickly second leaf, seems at the point of death, water the sand with a weak solution of phosphorus, and the effect will be magical. The plant will put out new leaves and they will turn to a dark green and grow vigorously. No one of these three elements is more necessary than the other; all are absolutely essential. In the economy of life and prosperity on our earth it is, therefore, simply a question of the adequacy of their supply.

So let us turn again to the Roosevelt inventory of natural resources.

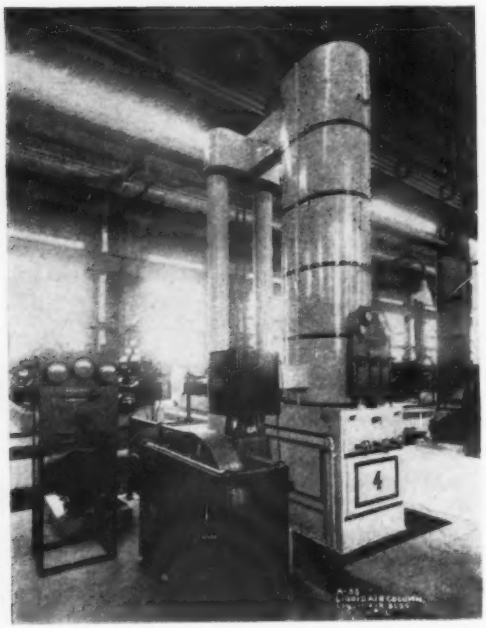

FIGURE 4.—A Claude liquid air column for extracting nitrogen from the atmosphere. This column has a capacity of 500 M^3 (17,500 cu. ft.) of nitrogen per hour. (Courtesy of U. S. Gov't Laboratories.)

What did it find with respect to these three fertilizing elements? First, nitrogen. This element is the most expensive, and likewise in soil the least persistent of the three. The farm supply has heretofore been obtained from various wastes and refuse, but by far the greatest amount through the growing of leguminous crops—the clovers, alfalfas, vetches, and cow-peas, which have the faculty of capturing the free nitrogen from the unlimited supply in the air. Extracting vast quantities of this useful element from the atmosphere, the many species of this great family of plants store it in their leaves, stalks, and roots, and it is thus ultimately transferred to the soil. The leguminosae have, therefore, been in reality the mainstay of agriculture the world over. But, large additional amounts are now required under our special cropping conditions where the "clover rotation" is perhaps not practicable, or where soil has become clover-sick, or for some other reason deficient in nitrogen. In all intensive crop culture it is highly essential, and for this element the United States was found to be dependent upon a foreign country—the great Chilean deposits of nitrate of soda, of which we were importing at the time of the Roosevelt Conservation Congress about $16,000,000 worth annually.

In the matter of phosphorus we found ourselves somewhat better off, yet to the far-sighted economist the outlook was decidedly gloomy. Our known phosphate rock deposits, the principal source of phosphorus, for fertilizer, were located in South Carolina, Florida, and Tennessee, with some low-grade phosphates in Arkansas, while there was also known to exist some phosphate in the West. However, in 1908 the United States Geological Survey's estimate of the total phosphate reserve of the country showed that at the present rate of production the South Carolina deposits would last only 15 years, the Florida deposits about 12 years, and the Tennessee deposits perhaps 50 years. Combined, our total phosphate resources had an outlook of about 30 years ahead, and this allowed for no increase in production.

For potash, the third element, we found ourselves absolutely dependent on the potash mines of Germany, then a world monopoly, and we were importing about $15,000,000 worth annually. Surely, America did not lead in known fertilizer resources.

But, our scientists were hopeful, if not confident, of bringing about an improved showing in all of these American necessities. There were already experiments under way to

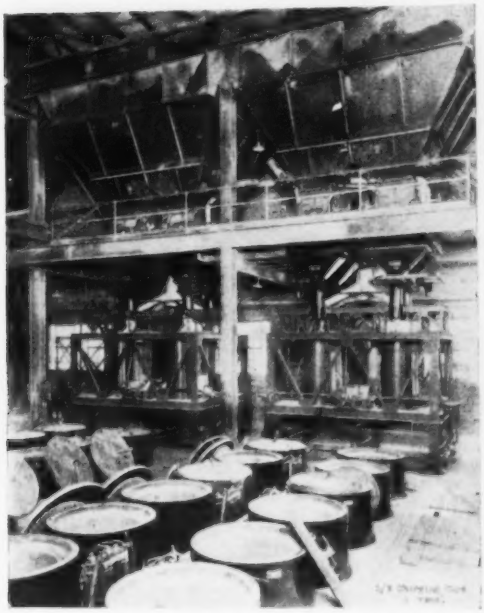

FIGURE 5.—Ovens in which calcium carbide is nitrified forming calcium cyanamide, the fixed nitrogen product of the cyanamide process. (Courtesy of U. S. Gov't Laboratories.)

capture nitrogen from the air by certain electrolytic processes and there seemed good chances of finding additional deposits of phosphate rock, as well as discovering deposits of potash salts similar to the great beds at Stassfurt, Germany.

All three attacks were prosecuted simultaneously and it may now be said, in a word, that all have been successful. Processes for extracting nitrogen from the air are now commercial successes and with our great available water powers in the United States, we can always manufacture nitrogen salts sufficient to supply all possible needs. We will never again be dependent upon a foreign country for this important fertilizing, as well as war, mineral.

The story of the exploration and determination of America's phosphate resources is an interesting chapter in governmental activities. Immediately following the Roosevelt inventory the Geological Survey sent geologists into the Southern States to make a survey of their phosphate resources and into the West to determine something of the scope of the little-known deposits of that region, and from a supposedly scarce and apparently rapidly diminishing fertilizing material, phosphate quite suddenly became one of our inexhaustible resources. Much larger deposits were found in South Carolina, Florida, and Tennessee than had been known to exist, while in the Western States the discoveries were spectacular. The phosphate beds were traced through Utah, Wyoming, and Idaho, deposits concerning a few of which something had been locally known but passed by unheedingly in the search for gold and silver and other metals and which it took the trained geologist to trace out through the rock strata. The Geological Survey's first estimate, or rather guess, of the tonnage in the ground of these western deposits appears to have been one hundred million tons, but a couple of seasons of energetic geologic field work and laboratory analyses developed the fact that

FIGURE 6.—Liquid air building interior, showing the 30 liquid air columns of a capacity of 17,500 cu. ft. of nitrogen per hour each and the compressors for compressing the air. (Courtesy of U. S. Gov't Laboratories.)

enormous areas were underlain with fine thick beds of solid rock phosphate—a most astounding discovery, which soon warranted an estimate of over a billion tons of high-grade phosphate, running 70 per cent or over of tri-calcium phosphate, with a constantly increasing tonnage estimate as new beds were discovered and measured and their bulk calculated. So that now the record shows that the Geological Survey has examined and classified as "phosphate land" 297,705 acres in Wyoming, Idaho, Utah, and Montana, with an estimated tonnage of 5,830,000,000 long tons, an adequate supply for the farmers of the United States, if not the world, for a great many generations to come. With all this vast tonnage disclosed, the present search for discovery is not so keen and the work is progressing more leisurely due to the many other demands on the small appropriations of the Geological Survey; yet, because it is realized that the fertilizer industry is in its infancy in the United States, it is more than gratifying to know that there are 2,050,912 additional acres of public, reserved land in this western phosphate field that have not yet been examined in geologic detail and for which no tonnage estimate has been made. Scientists, and perhaps especially geologists, are apt to be very conservative, but if you could get them to guess at the tonnage of these deposits I have reason to believe that it would be an additional five, and possibly ten billion tons. Indeed the Director of the Geological Survey has himself stated that the public lands alone contain a probable eight billion tons. It does not seem at all impossible that when the geologic surveys have all been completed, our total reserve phosphate tonnage may prove to be as much as fifteen billion tons. It is also a matter of satisfaction to many to know that title to practically all of this western phosphate is in the Government and that the phosphate can be mined only under leases granted by Uncle Sam himself.

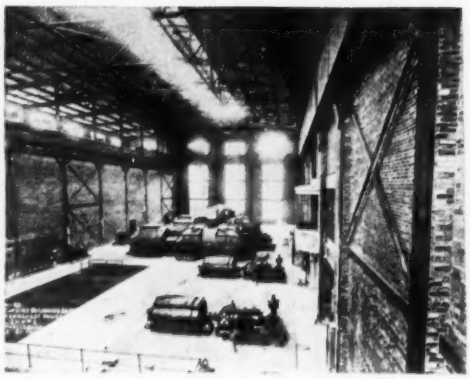

FIGURE 7.—The turbine room with its powerful units at the Muscle Shoals development in Alabama. (Courtesy of U. S. Gov't Laboratories.)

The addition of Montana to the original western phosphate states is an interesting example of a community having unwittingly harbored an angel in rough disguise. The western phosphate rock is rather common-looking stuff, black, brown, or grayish, and inconsequential. It is composed of minute rounded grains formed by organic and chemical agencies way back in the Carboniferous Period. It has, of course, none of the spectacular sharks' teeth of the Florida phosphates which are of Tertiary age. And so it happened, that as geologist Hoyt S. Gale, who had been working in the phosphate fields of Idaho and who was the following year sent up into Montana to carry on another line of investigation, stumbled across a piece of gray rock, he immediately recognized it as of the same formation as the more southern phosphate deposits. The result was the with-

drawal of a large acreage in Montana as "phosphate reserve." Furthermore, it was Mr. Gale's belief that the great stretch of intervening country between these Montana beds and those to the south may not itself be devoid of phosphate rock.

The phosphorus story would not be well rounded out without at least

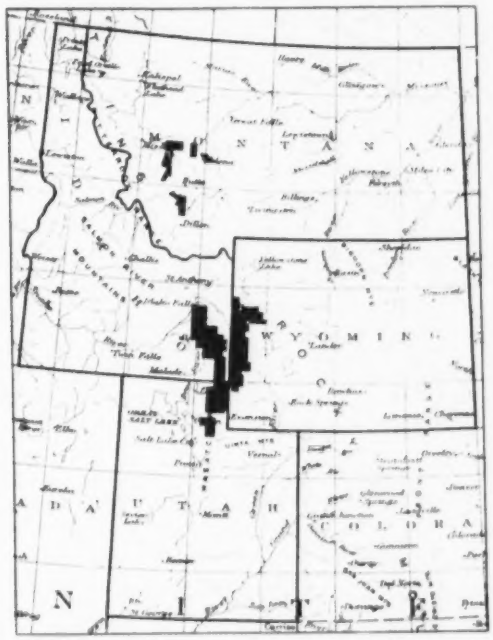

FIGURE 8.—Original government withdrawals from entry of over 3,000,000 acres of land underlain with phosphate rock. Some of these areas, found upon detailed surveys to contain no phosphate have been restored to the public domain.

one or two examples of the value of this mineral as a soil stimulant. The Indiana Agricultural Experiment Station at Purdue University in a recent report remarks that it takes about as much labor to mature a poor crop as it does a good one and then cites some crop experiments with phosphate that are astonishing. The experiments were no laboratory pot tests, but included a great number of crops grown in the field during a series of years on ordinary soils of different kinds and in seven different parts of the State. The ordinary soils of Indiana, it is stated, need phosphate more than any other fertilizer; they have been deficient in phosphorus from the beginning and with the system of farming commonly followed during the last half century they have been further depleted of this element. In Scott County a badly run-down field was planted to corn, with no fertilizer. The yield was only 23 bushels per acre. An adjoining field received a small application of phosphate and yielded 32½ bushels. In another test a no-fertilizer field yielded 29½ bushels of corn and an adjoining similar field where phosphate was applied yielded 48 bushels. In a Green County experiment where the soil is naturally good a lime-manure fertilization yielded 44 bushels of corn, but an addition of phosphate increased the yield to 52 bushels. The next year without further fertilization the same fields were planted in wheat and yielded respectively 11 and 14 bushels, and the third year hay was planted, yielding respectively 3,300 and 4,900 pounds to the acre. Thus, in the three years one application of $2.25 worth of phosphate yielded an increase of 8 bushels of corn, 3 bushels of wheat, and three-quarters of a ton of hay, worth at the time of the experiment more than ten times the cost of the phosphate which produced them. In Lawrence County lime alone was applied to a field and brought 34 bushels of corn per acre, but when phosphate was added the yield was 47 bushels. In an experiment on another soil, lime and manure yielded 38 bushels of corn, but, with $3 worth of phosphate added, brought 64 bushels, an increase of 26 bushels per acre. A hay field with lime yielded 1,600 pounds

of clover hay while the adjoining field with lime and phosphate yielded 4,000 pounds. The Purdue report bristles with the results of dozens of such experiments showing greater or less profit from the use of moderate quantities of phosphate, but in no case on Indiana soils has it failed to give handsome profits. And, the Purdue experiments are only one of a great number of series throughout the Eastern and Middle Western States carried on by State Experiment Stations and agricultural universities. Even in the Far West on irrigated lands, phosphate is coming to be recognized as a splendid investment in the growing of alfalfa and other field crops.

And now we come to the third member of the agricultural trinity—potash. Incidentally, perhaps primarily, in time of war, potash is a prime necessity in the manufacture of explosives.

Potash is a plentiful element in Nature and large quantities of it are found in most soils and in many rocks. It constitutes nearly 3 per cent of the earth's crust, but most of it is insoluble and unavailable for the use of plants. In Nature it breaks down slowly, so that our wholesale exportation from the farm of soluble potash as contained in grain and other farm products makes necessary the application to the soil of soluble potash in concentrated form—potash salts. Well, prior to 1908 we were groping around leisurely for a domestic potash supply, but were importing about $16,000,000 worth a year from Germany. Then, in 1910 the Germans tore up the contracts they had made with American buyers as "mere scraps of paper," increased the price, and made us sign new contracts—or go without potash. This stirred us up considerably and we started out vigorously to find our own potash. The Geological Survey and the Bureau of Soils were given small appropriations by Congress and systematic campaigns of discovery were inaugurated. The Bureau of Soils undertook to find processes for the extraction of potash from the various potash-rich rocks, from the giant seaweed, kelp, and from other sources;

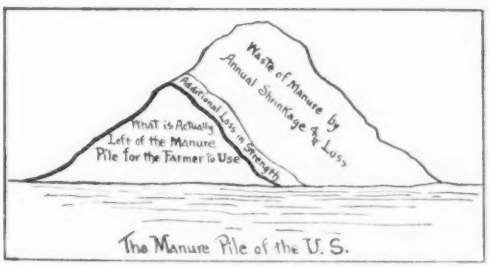

FIGURE 9.—A graphic story in the waste of plant food from the stable manure piles of United States farms—one reason we need commercial fertilizer.

the Geological Survey to investigate the brines and bitterns associated with salt deposits in various states and to drill for potash beds in the prehistoric lake basins of the West. Thousands of chemists, both professional and amateur, strove to find the elusive combination that would release the tightly bound potash from its natural insoluble state, and many processes were discovered and even patented which in the laboratory promised success, but when applied commercially proved too costly. The Geological Survey made thousands of analyses and began its drilling campaign in the West. Then came the war, with potash imports entirely cut off, and efforts were redoubled to find American potash. The country was raked from end to end, and with prices advanced to the fabulous figure of over $400 a ton,

FIGURE 10.—Drilling for potash in New Mexico under government direction; the possible field of profitable production covers 40,000 square miles.

considerable American potash was actually produced, but at great cost. During the year of our greatest production, however, 1918, we were able to produce only one-fifth as much as we had imported in 1913. With the close of the war and the resumption of German imports, nearly all American potash plants were forced to close down, and the plant at Searles Lake, California, is today the only appreciable producer. Last year our total American production was only a little more than 10 per cent of our imports. The Searles Lake operation, which is said to have some thirty million tons of potash "in sight," is certainly a valuable resource, although it is not so cheap a source of potash and has no such potentialities as are needed for an adequate American potash supply to meet the countrywide needs of the future. It will be remembered that during the Armistice period the good news was circulated that Alsace-Lorraine contained great deposits of potash, for practical purposes almost comparable to those of Stassfurt and sufficient to supply the world with potash for many years if not centuries. Surely now, we had a claim through France for generous and fair treatment, something entirely different from that we had received from Germany. This pleasant thought was due to receive a violent shock. In 1924 the French and German representatives of the potash industry signed an agreement governing their exportations to the United States and dividing the market between themselves, so that America again faced a practical potash monopoly. The price fixed is believed to be about what the traffic will bear, and it is believed at such a figure as to discourage American exploration and the building up of a domestic American potash industry. And then, of course, there is no assurance that potash contracts in 1927 or 1928 will be held as any more sacred than they were in 1910.

Thus, we find the third and the real key to American agriculture in the hands of a foreign combine. There are, of course, three such keys of equal value for this combination lock—nitrogen, phosphorus, and potash. No one, nor no two, of them will open the lock, but for America the *big* key at the present time is potash, for the reason that we have the phosphorus key and the nitrogen key. This foreign attitude toward the great potash market of the United States, beginning with the torn-up contract incident and now being followed by the farming out of American purchases between French and German potash producers has

worked a genuine hardship on American farmers; yet, it has surely proved a blessing in disguise, for now we have found our own potash.

And, this is the story of it. Working along quietly and patiently upon what they have from the beginning held to be the most promising line of investigation, the geologists of the Geological Survey have searched with persistent effort the prehistoric basins of the West for a big deposit of soluble potash salts—a deposit comparable to the Stassfurt deposits of Germany. After careful geologic investigation, the Geological Survey drilled holes in a number of Western States, finally selecting Texas as the most promising field. In 1912 potash was first reported in Texas by Udden and within the last eight or nine years large areas in Texas and New Mexico have been invaded by wildcat oil men. Their operations covered in part the great Red Beds saline area of portions of Texas, New Mexico, Oklahoma, and Kansas, which were believed by geologists to be a most likely potash area, similar in its geologic history to the German potash area. Here appeared to be a golden opportunity. Instead of continuing to spend its meager appropriation in drilling a few wells—looking for a needle in a haystack—the Geological Survey set its specialists to watch the results of the oil drillers in this area and also made many thousands of analyses of oil well drill cuttings. The results brought the Survey nearer and nearer to its goal. Before 1921 there were but three oil wells, all in western Texas, from which potash showings had been reported. By the close of 1926 some 76 wells had been examined in Texas and New Mexico, and the number of counties known to possess substantial potash deposits had been increased to 19 in Texas and 3 in New Mexico, with the list continually growing. The results showed potash, potash everywhere. Qualitative results were good, but owing to the fact that oil drillers used the churn drill little or no quantitative data resulted. Core drilling was necessary to determine the thickness of the beds, and finally Congress recently authorized a five-year drilling

FIGURE 11.—An illustration of the beneficial effect of potash upon the typical black mucky soil of the Corn Belt; the corn to the left is on potash-treated soil; on the right no potash but all other fertilizers have been added.

campaign with an expenditure of $500,000 and appropriated $100,000 for the first year. Before the Government could get down its first well, however, a private corporation, the American Potash Company of New Mexico, in coöperation with the United States Geological Survey, core-drilled a well on Government land in Eddy County, New Mexico, to a depth of 1,890 feet, and disclosed apparently workable beds of soluble potash salts.

The results were almost spectacular when it is remembered that this was the first well core-drilled in a potash area of roughly 40,000 square miles. The beautifully colored cores of potash salts received at the Geological Survey for analysis aroused no little enthusiasm and the laboratory tests gave good results. They showed that between the 790-foot depth and the 1,890-foot depth there are beds of potash aggregating 35 feet of potash salts with ten of the beds described by the Survey as of possible commercial value. The most promising deposit is in two beds very close together constituting a single mining unit of 5 feet 3 inches of potash salts analyzing nearly 15 per cent potash (K_2O), which is richer than the average German beds. Other beds carry greater or smaller percentages, one analyzing 18.5 per cent potash. It is to be noted that the Stassfurt shafts are from 1,200 to 3,500 feet deep—generally deeper than the Eddy County well—with a few reaching 5,000 feet while the Alsace mines range from 1,600 to 2,600 feet deep. Earlier Geological Survey analyses in Texas and New Mexico had disclosed polyhalite as the only potash mineral, but the American Potash Company drill core showed a number of important potash minerals new to the United States. Dr. G. R. Mansfield, the geologist in charge of the potash investigations of the Geological Survey, remarks that "in this discovery we have several potash minerals new to America and it is probable that with additional drilling we will find others, which all means that we are getting nearer and nearer geologically to the German situation." The director of potash operations in Alsace is reported as having stated recently that they were not at all alarmed over the discovery of polyhalite in Texas. Now, however, the European combine is confronted with both quantitative and qualitative data from the first

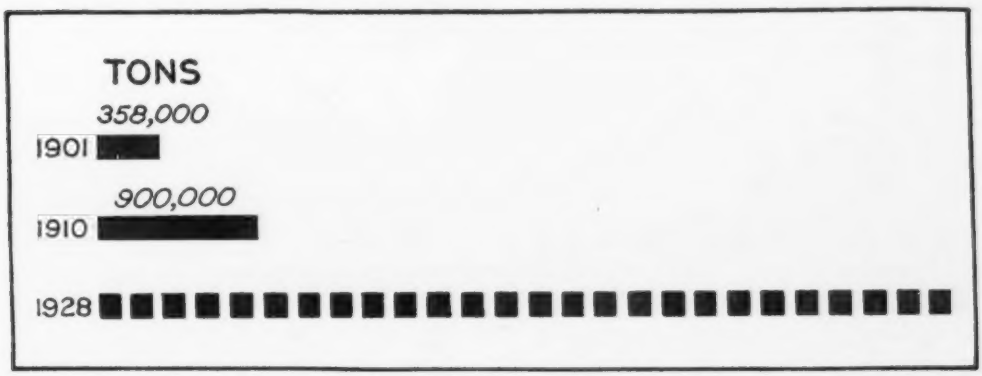

FIGURE 12.—A graphic representation of the increase in the use of potash as a fertilizer in the United States since 1901.

drill hole in a great potash area of something like 40,000 square miles that point definitely to deposits of various kinds of potash salts, some of them much richer than polyhalite. Concerning the significance of the showing from this first core-drilled well, Dr. Mansfield remarks: "It would be rather strange if the drilling of this first well in a 25 million-acre potash area should have happened to strike the best bed in the area. In thousand feet there are 30 beds of potash salts carrying 12 to over 18 per cent of potash. These beds represent 30 chances for a supply. If we assume that one bed will grow thin as it recedes from the test hole we must assume that another bed will grow thicker."

On the facts developed from one drill hole, geologists have been loathe to discuss possible tonnage of deposits; nevertheless, it may be pointed out

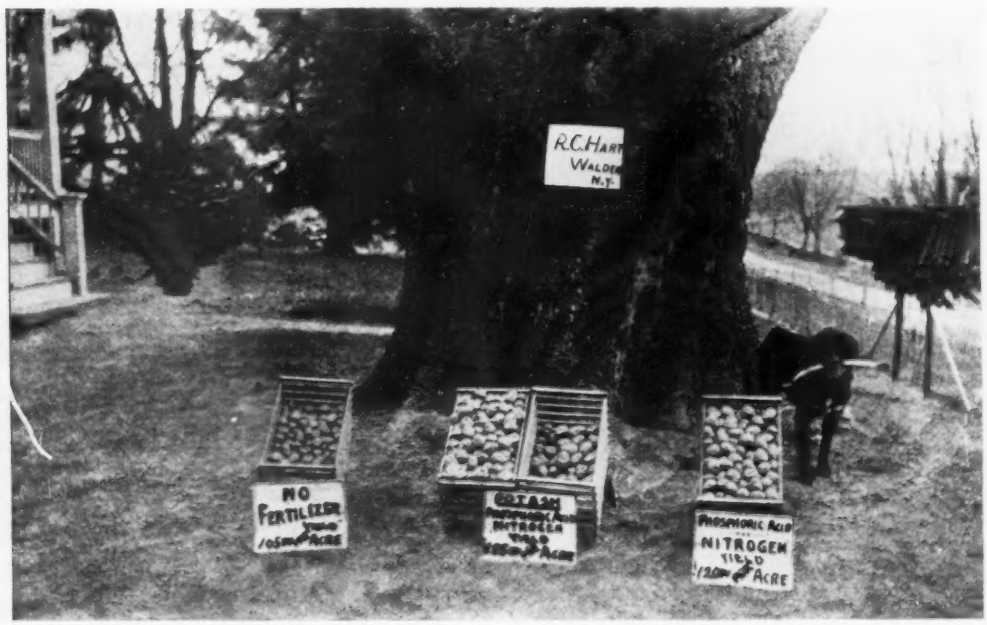

FIGURE 13.—Even potatoes grow biggest and best in soil adequately supplied with potash. It is one of the keys to profitable yield.

the light of all the evidence we have accumulated, it looks as if the discovery marks the successful culmination of America's fifteen year search for potash." Dr. George Steiger, chief chemist of the Geological Survey, adds that "it is not unreasonable to suppose that the Texas-New Mexico deposits contain enough potash to supply the world for thousands of years. The drill in the American potash well went down 1,890 feet. In the range of the last

that the content of the one bed of the New Mexican well already mentioned as 5 feet 3 inches thick contains approximately 20,000 tons to the acre, so that if this bed should extend out from the well hole only one mile in each direction, it would contain over 40,000,000 tons of potash salts. However, geologists and capitalists alike should not be long in suspense as to the extent of the deposit. The American Potash Company is following out a program

of core drilling of a group of additional wells, in coöperation with the Geological Survey, to clearly define the potash beds in this locality, which the company states will be followed, if the results warrant, by the sinking of shafts and the mining of the potash, as well as the erection of concentration plants.

From the wells the Company has already drilled potash strata of remarkable thicknesses. These have been traced from well to well indicating with fair certainty that workable buds of several kinds of potash salts underlie an area of some 25 square miles in this one locality. A number of government wells have also been core-drilled in both New Mexico and Texas, all bearing out the general conclusion that America has at last found its potash supply.

The goal has apparently been reached, and it seems that we may consider ourselves as in fact delivered from the domination of a most troublesome foreign monopoly. If not another stroke of work were done in developing potash in the Southwest, American freedom from monopoly-control appears assured. The mere fact that we have the potash and that it can be mined will act as a dependable guaranty to keep down the price of potash importations produced by the Franco-German combine or any other foreign producers who may enter the field. But, it is not to be assumed for a moment that American enterprise will permit such a mineral resource as is apparent in our potash lands in the Southwest to lie idle when there is an American market at hand amounting to millions of dollars of purchases annually. Everything points to a great future American potash-producing industry. This culmination of the Geological Survey's long search for a necessary mineral resource may be looked upon as one of the great triumphs of scientific exploration. That this discovery of potash, in amounts that it is hoped will place us upon all-fours with Germany, is a really great achievement is attested by the words of Director George Otis Smith of the Geological Survey in a statement made to American bankers in 1924.

FIGURE 14.—A poor stand of artichokes on unfertilized soil. The sandy soils of the Atlantic and Gulf coastal plains are easily tilled, are deficient in plant food, and so require heavy fertilization to produce good crops. (See Figure 15.)

"The value to the United States of a deposit of potash comparable with the German deposits," Dr. Smith said, "would be almost beyond calculation, constituting a mineral resource compared with which all the gold mines in the country would sink into insignificance." This is a most forceful statement, but perhaps no more arresting than a statement of Dr. David White several years ago when Chief Geologist of the Geological Survey and then in general charge of potash explorations. Dr. White said:

"A more widespread and effective fertilization of the soils of the United States is not merely an agricultural requirement, it is a national necessity

FIGURE 15.—A heavy stand of artichokes on an adjoining well-fertilized plot of coastal sandy soil. When adequately fertilized these light soils of the South yield heavily. (See Figure 14.)

on which depends the commercial welfare and prosperity of our country in the future. Our position in international trade and our national financial independence, not to say dominance, cannot be sustained indefinitely by the sacrifice of our irreplaceable mineral deposits; a balance of trade in favor of this country cannot always be maintained through the sacrifice of our oil, our copper, our sulphur, and other mineral heritages in order to make good a deficit met in former years by the export of food stuffs not needed in our own country.

"The present trend of enormous increase in the consuming population which so rapidly swells our cities; of arrested growth of agricultural population and production, and of faltering if not actually doubtful recuperation of our worn-out or rapidly exhausting soils, constitutes a menace to this nation of which the disastrous and far-reaching significance is not realized by a public habitually optimistic and blindly complacent. This is the most important economic problem of the United States. Beside it our war debts are trifling and ephemeral. Times have changed and are still changing. Either we must shift our economic basis back to the exportation of replaceable food stuffs in larger amounts to maintain our trade balance or we must gravitate insensibly into the manufacture of raw materials, imported as well as domestic, on a plane of competition gradually approximating that of the Old World nations. The latter course will inevitably entail not only a continuous stern struggle for commercial prestige and independence, but a sacrifice of our standards of living as well. The productivity of American soils must be restored by every practicable means. Nothing that will lessen the cost of fertilizers or promote their wider and wiser use on our lands can be overlooked or allowed to stand in the way. The interests of the public demand early and reliable information as to the exact thickness, extent, composition, centers of richness, availability, and possible utilization of the potash deposits in the Southwest."

POSSIBILITIES OF RUBBER PRODUCTION IN CARIBBEAN AMERICA

Jewell Venter
Economic Geographer, University of Missouri

THE problem of the United States' future rubber supply is such as to demand serious consideration. During the year 1925 this country consumed 75 per cent of the world's supply of rubber, although 85 per cent of such supply was produced and controlled by a single foreign country. Due to the probability that our annual consumption of rubber is likely to increase, it is essential that producing areas be developed under economic control of the United States. Caribbean America offers opportunities for such development.[1]

In view of this fact it is the purpose of this paper to present data concerning locations, sizes, and extent of areas in Caribbean America offering such opportunities.

In considering the suitability of these areas for rubber production it seems advisable to compare environmental conditions in Caribbean America with the general conditions under which commercial rubber is produced.

Conditions Suitable for Rubber Production

In general, *Hevea braziliensis* grows in tropical and sub-tropical areas, such as the East Indies, which have a moist, warm climate and a deep soil of suitable physical texture. There should be no excessive temperatures, no morning rains, and little or no wind. A rainfall of 70 inches is ample, provided it is fairly evenly distributed throughout the year. Land which is slightly rolling and readily drained is most suitable.[2] Rubber thrives best in a light to medium sandy loam. Provided soil conditions are right, a dry season of several months is not a serious handicap.[3] In addition there should be an adequate supply of capital, cheap labor, transportation facilities, and a stable government.

General Physical Environmental Conditions in Caribbean America

Mexico consists mainly of a high plateau; however, the peninsula of Yucatan and comparatively narrow strips of land along the coasts are low. Such lowlands are tropical, and, in general, offer splendid opportunities for agriculture. Central America is characterized by a marked contrast between high mountains and low plains. With the exception of the Lake Nicaragua Lowland the plains are located along the coasts, the largest areas of which are along the Caribbean. In most cases these plains, although not continuous, are wet and hot and well suited to various types of tropical agriculture. The islands of the West Indies, which

[1] Bell, P. L., *Colombia, A Commercial and Industrial Handbook.* Bureau of Foreign and Domestic Commerce, Special Agent Series No. 206, p. 87.

[2] Schidrowitz, Phillip, *Rubber*, p. 48.

[3] Figart, David M., *The Plantation Rubber Industry in the Middle East.* United States Department of Commerce, Trade Promotion Series No. 2, p. 12.

are the projecting portions of mountain ranges, possess considerable areas of low, flattish, and in most cases, wet coastal lands, which are available for tropical agriculture.

A general survey of Caribbean America, as given above, leads one to conclude that in this general area there are a considerable number of regions which might be used for the production of rubber from *Hevea braziliensis*.

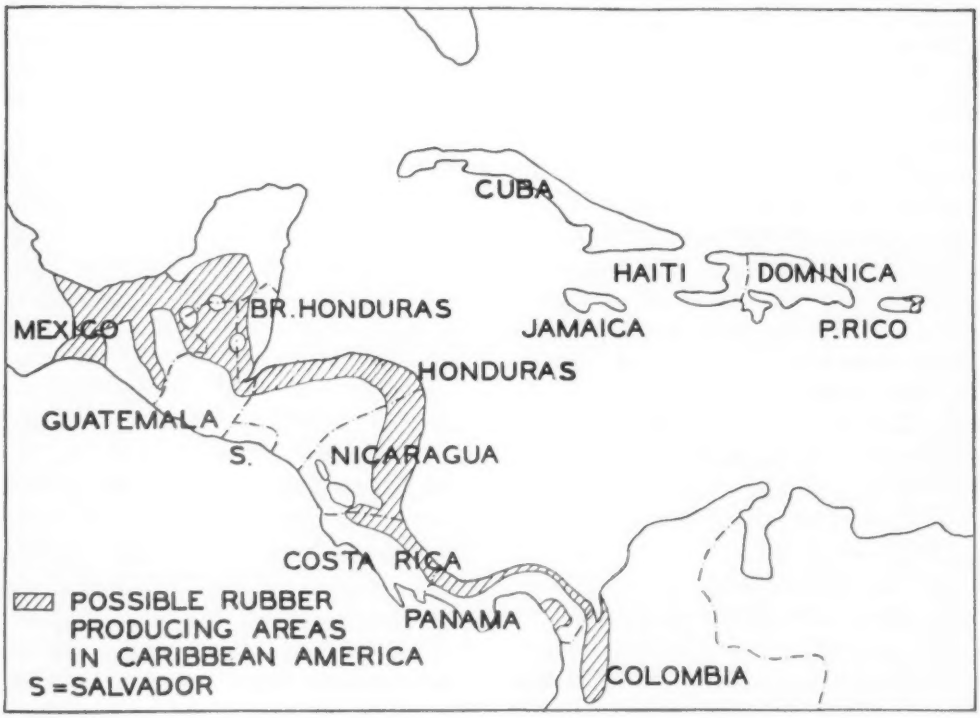

FIGURE 1.—The extension of rubber production into Central America, particularly along the Caribbean coast depends upon the selection of habitat favorable to the growth of *Hevea braziliensis*.

Favorable conditions, with the exception of adequate transportation facilities and a stabilized government, exist in southern Mexico for the production of rubber. The tropical lowlands of the Tehuantepec Isthmus with its abundant rainfall (nearly 200 inches per year),[4] favorable atmospheric conditions, and rich virgin soil, have about 10,000,000 acres which might be developed. Due to the gradual decline of rainfall east of Tehuantepec [5] vast areas along the coast, which are otherwise suitable,

SPECIFIC AREAS FAVORABLE FOR RUBBER GROWING

Among these potential areas the following regions are the most important: the Tehuantepec Isthmus and portions of the state of Chiapas and Campeche in southern Mexico, the department of Peten in northern Guatemala, the Caribbean coastal plain in Honduras, Nicaragua, Costa Rica, and Panama, and the Coele and Chincunaqui River basins in Panama.

[4] Smith, J. Russell, *North America*, p. 767.
[5] *Ibid.*

cannot be used. In Chiapas the numerous low-lying river bottoms, such as the Grijalva,[6] with its rich wet soil, offer an available area of at least 1,000,000 acres, and in the southern portion of Campeche near Conception, where the rainfall is more than 70 inches, about 1,000,000 acres are suitable.

The flattish areas of volcanic soil around Lake Peten and the tributaries of the Paston and Usumacinta Rivers in northern Guatemala possess the essential requirements with the exception of poor transportation facilities.

The broad belt about 150 miles wide and 400 miles long on the northern coastal plain in Honduras offers another promising field. The normally torrid climate of this plain is modified by the trade winds and a rainfall that is well distributed.[7] About 15,000,000 acres of the alluvial soil which is enriched by the decaying jungle vegetation is suitable for the production of rubber. Transportation, which is inadequate, is practically dependent upon the railroads of the fruit companies which operate extensive banana plantations in this area.

Portions of the eastern coastal plain of Nicaragua which are not in swamps or more than 2,000 feet in elevation offer about 4,000,000 acres of suitable land. Such areas are the natural home of the rubber plant.[8] Sections near the Grande and Bluefield Rivers are exceptionally well drained. The most serious handicaps in this locality are a scant labor supply and poor methods of internal communication.[9]

There are approximately 2,500,000 acres of suitable land in Costa Rica and Nicaragua. The San Juan River and its tributaries, the San Carlos and the Sarapiqui, offer similar opportunities as the above-mentioned areas in Nicaragua.

The potential areas in Panama are irregularly distributed along the Cordilleran Range. The fertile soil of the river valleys, the rainfall of at least 133 inches a year and a temperature averaging 72 degrees Fahrenheit are ideal conditions for rubber growing.[10] The Coele, Tuyra, and Chucunaque River basins, and the coastal strips near Bocas del Toro and the Gulf of Darien have approximately 2,000,000 acres which are probable productive areas. In addition to the poor methods of internal communication is the problem of dealing with several Indian tribes who refuse admittance to any outsiders.[11]

The Atrato River Valley of Colombia offers better opportunities than any other region bordering on the south shore of the Caribbean Sea. The extreme heat near the coast is tempered by the northeast trade winds. Rains are practically incessant; the average annual precipitation being about 160 inches.[12] The difficulties are the common ones of inadequate transportation and an insufficient supply of reliable labor.

In Porto Rico approximately 500,000 acres of the alluvial plains and the more level portions of the

[6] Firestone, Harvey S., "We Must Grow Our Own Rubber," *Saturday Evening Post*, April, 1926.

[7] Harris, Gerrard, *Central America as an Export Field*. Department of Commerce, Bureau of Foreign and Domestic Commerce, Special Agent Series No. 113, p. 85.

[8] Smith, J. Russell, *North America*, p. 757.

[9] *Op. cit.*, p. 140.

[10] Harris, Gerrard, *Central America as an Export Field*. Department of Commerce, Bureau of Foreign and Domestic Commerce, Special Agent Series No. 113, p. 205.

[11] *Op. cit.*, p. 199.

[12] Bell, P. L., *Colombia, A Commercial and Industrial Handbook*. Bureau of Foreign and Domestic Commerce, Special Agent Series No. 206, p. 32.

limestone belt along the northern coast might be used. The abundant annual rainfall of at least 75 inches, the year-round growing season, the abundant labor, and easy means of transportation by rain and wagon roads are conducive to rubber production.

PROBLEMS OF PRODUCTION

The availability of many of these potential areas involves several outstanding problems, the most prevalent of which is that of transportation. As a result of continuous heat and abundant moisture the thick forest in many places is tied together by creepers which seem always to encroach on the right of way of the few existing roads and railroads. Streams, therefore, offer practically the only available means of transportation. Many of the areas are covered with thick jungle and must be cleared and stumped before they are ready for planting. The marshy and swampy areas, which offer an ideal home for the mosquito, must be drained before healthful conditions can be brought about for the promoters and laborers. Sections having winds of cyclonic force cannot be used.

In the past many foreigners have financed uprisings and rebellions in these countries so that they might reap excessive profits from some enterprises in which they are interested. Such rebellions have caused the United States much trouble since, according to the Monroe Doctrine, we consider it our duty to help protect these Latin American countries.

In general an adequate supply of dependable labor cannot be obtained, as the natives on account of the enervating climate are quite lazy and docile. As a rule they are contented with a bare existence and prefer piece work to a steady job.

CONCLUSION

A study of the general conditions leads to the conclusion that rubber production can be developed in Caribbean America. Such problems as occur can, in most cases, be overcome in as much as there are but few of them found in each area. The greater part of some 40 million acres suitable for rubber production are located in the eastern tropical lowlands and river valleys. These areas, after they are fully developed, will probably compete with the present producing areas upon which the United States is now dependent. If the annual consumption of rubber in the United States continues to increase at the present rate a large portion of the additional amount required can be produced in Caribbean America.

THE GEOGRAPHIC SURVEYS OF KENTUCKY

A Review

W. Elmer Ekblaw
Agricultural Geographer, Clark University

THE Kentucky Geological Survey, in its six volumes on the regional geography of the state, has established a precedent that might well be followed throughout the country. The careful work that this series presents provides the firm basis for further detailed surveys of the state which shall determine the wisest utilization of its lands and other resources, the fullest development of its industries, and the happiest associations of its people. It is the kind of work that will have to be done throughout the length and breadth of our land, if the problems of maintaining the present standard of living for an ever increasing population and a relatively stationary supply of land and basic raw materials are to be solved.

These problems, though not as yet pressing sorely upon our people, will in time probably not so far distant engage the attention of our scientists and statesmen as never before. The abundance of free land, the rich native endowment in forest, and soil, and mine, and the favorable economic and political conditions under which they have been exploited have thus far freed our people from the worry of limited supplies and resources, but the day is even now at hand when we must begin taking serious "thought for the morrow." And this the Kentucky Survey has done.

In the series of six volumes the six distinct physiographic regions of Kentucky have been separately discussed on the basis of careful field studies and surveys. These regions are (1) the Jackson Purchase, which constitutes the western tip of the state; (2) the Kentucky Mountains—the eastern highland section; (3) the Western Coal Field, which occupies the northwestern section of the state; (4) the Knobs, which form the hilly boundary about the Blue Grass Region and constitute the transition from the Blue Grass to the Mountain district; (5) the Blue Grass, which occupies the northern tip and most of the north central part of the state; and (6) the Pennyroyal, which lies south of the Blue Grass and the Western Coal Field and projects between these two regions to the Ohio River and between the Western Coal Basin and the Jackson Purchase.

The Jackson Purchase

The Jackson Purchase, which was the first of the regions treated, includes eight counties lying west of the Tennessee River, so located that it is easy of access by navigable streams from all directions. Because the relief of the region is slight, railways are relatively numerous and the old focus of waterways about which the region centers is supplemented by a fairly comprehensive railway net. The average elevation is somewhat less than 400 feet above sea level, greatest in the southwest cor-

ner where the Tennessee Ridge enters the state.

The natural resources are varied, but the favorable climate and the generally fertile soils have made agriculture the dominant industry, though lumbering has in the past supplemented considerably the farm income. The staple crops, corn and tobacco, constitute about 75 per cent of the total agricultural production. Corn is the staple cereal crop of widest distribution and highest value. Wheat ranks a poor second and the other cereal grains are insignificant. Cotton is an important crop in some sections. Tobacco is the cash crop or money crop throughout most of the region, and upon its yield depends the prosperity of the people. There is considerable variation in the condition of life in the rural districts, some of the sections being backward while others are progressive.

The Survey points out the errors in the utilization of the land and the maladjustments of the people to the physical conditions wherever they have occurred, and emphasizes the fact that the region must improve to maintain its economic position, while failure to do so will certainly result in rapid retrogression. The region is potentially rich. The people are of good American stock, and if they will direct their activities along the lines the Survey has pointed out, they must surely advance.

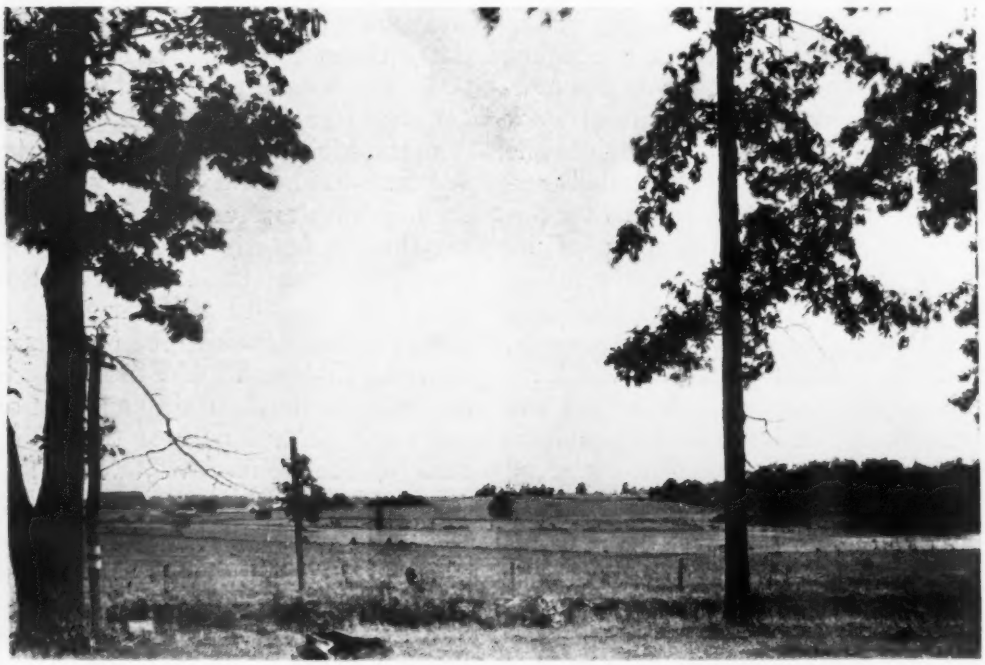

FIGURE 1.—Southern Jackson's Purchase, near Tennessee Line. Standard oil derrick drilling at Fulton, Kentucky, faintly distinguishable on the low hill in the background. (Courtesy of Kentucky Geological Survey.)

THE KENTUCKY MOUNTAINS

The Kentucky Mountains, the subject of the second volume, embraces all the region east of the line drawn from Portsmouth on the Ohio River to the southwest corner of

Wayne County. Occupying a peripheral location with reference to both land and water highways the region has been difficult of access, and for a long time was not occupied, and then only slowly and with difficulty. The relief contributed in no small part to this tardiness of settlement because the region is a maturely stream-dissected plateau in which the valleys of the streams are often hundreds of feet below the crests of the divides between. The soils of the hilltops and hillsides are thin, and eroding badly under cultivation, become valueless in a relatively short time despite their original fertility. The deeper alluvial soils of the stream valleys are fertile in comparison. The natural vegetation was of the oak-hickory and oak-chestnut types with a large variety of other species of hardwoods, many of them of great economic value. A great deal of the region is still timbered, so that lumbering constitutes an important industry, contributing to the dominance of Memphis as the hardwood center of the country.

Only a small part of the land should be engaged in crop production. Except on the level bottom lands, and some of the lower flatter ridges, silviculture would be generally more profitable than any type of agriculture. Corn is the most important cereal crop as well as the dominant cash crop. Over 90 per cent of the cereal crop of the region is corn. The animal industry of the section is relatively insignificant.

FIGURE 2.—A view in the Cumberland Mountains. Cumberland Gap and Pinnacle Rock as seen from the Middlesboro Road. (Courtesy of Kentucky Geological Survey.)

The Survey recommends a definite policy of further agricultural development in the region which differs radically from the recommendations for other regions. Living conditions in the whole region are notoriously below a desirable standard, and life is on the whole exceedingly primitive and difficult. The future of this

FIGURE 3.—A view in the Cumberland Plateau Region, Kentucky River, Middle Fork, Perry County, Kentucky. Panorama of cliff showing anticlinal fold at Buckhorn, Kentucky. This small fold is responsible for the varying elevations of the coals in this immediate vicinity (west half). (Courtesy of Kentucky Geological Survey.)

region is wrapt up in the development of its mineral resources, and upon their wise utilization depends the future prosperity of the people living within the area. The agriculture must become dominantly self-sufficing over most of the area. A general type of farming must be adopted and only the areas of best soil and level surface should be cropped. Silviculture and mining must yield the cash income.

THE WESTERN COAL FIELD

The Western Coal Field embraces an area 4,680 square miles in extent, 11.6 per cent of the total area of the state of Kentucky, and includes all or part of 21 counties lying roughly between North Latitude 37° to 38° and West Longitude 86°30′ to 88°. Measured in miles the greatest distance between opposite sides of the Western Coal Field is approximately 62 miles from north to south and 103 miles from east to west. This section constitutes the southeastern portion of the eastern interior coal field which also includes parts of Indiana and Illinois. The surface of the region is chiefly gently rolling to hilly uplands except along the streams, where flood plains poorly drained and often wet and swampy form bottom lands of low relief. The Ohio River, and the Green River which practically bisects the coal field, have played an important part in the settlement and early development of the area. The climate is typically humid, temperate and continental, with a mean annual temperature of 56.6°, a mean summer average of 75.9°, and a mean winter average of 35.5°. The average earliest killing frost comes about mid-October, and the average for the last killing frost in the spring is in mid-April. The average annual precipitation over the area is 45.15 inches. The climate is suitable for the growth of many crops typical of the Mississippi Valley, and represents fairly well the general type of climate of the whole state.

The most important natural resource is coal, the coal mining industry giving the region its distinctive stamp, and affecting the character of the social and economic life more than any other one factor. The coal is nearly all bituminous, though a small quantity of cannel coal is also mined. The coals are higher in average combustible matter and fixed carbon, and lower in average moisture, ash, and sulphur than the coal of other portions of the field, and so are better quality than Indiana or Illinois coal. They are well adapted to railway use and for industrial plants and homes, but the high sulphur content of some of the coal renders it unsatisfactory for coking for use in the iron and steel industry. Oil and gas of high quality, excellent clay and shale for brick and tile making, sand, gravel, and limestone for road building and other structural

FIGURE 4.—Western Coal Field. View of Pleasant Valley Coal Company's plant on the right, with 300 ton capacity per day, and Cox and Baker Tipple on the left, with 100 tons per day capacity. (Courtesy of Kentucky Geological Survey.)

purposes, and rich oil shales, potentially valuable for petroleum-production constitute the other mineral resources of the region.

Almost continuous hardwood forests originally covered the region. The most valuable trees have been felled and marketed, although on the bottom lands and on some of the steeper slopes trees of commercial value still await the axe and saw, and constitute a potential important addition to the income from the farms. The soil is relatively fertile and easily tilled, but readily eroded, even on only moderately steep slopes, except when protected by cover crops. The chief crops are corn, wheat, and tobacco, with forage crops grown to a limited extent in all of the counties. The yield per square mile is a direct function of the relief. The yield of corn in Union County, for example, which has a gently rolling topography over wide areas with 157.7 acres per square mile, was 4,385.6 bushels; in Henderson County, which also has a great deal of flat and gently rolling surface and 154.2 acres in corn per square mile, the yield was 3,636 bushels; Muhlenberg County, with 73.9 acres of corn to the square mile, yielded 1,349.9 bushels, where the relief is considerably more rugged.

Tobacco is probably the most important cash crop where it can be grown, even though corn be the staple crop. The tobacco is a dark type, grown upon heavy clay soil, and yielding between 750 and 800 pounds per acre. It rapidly exhausts the fertility of the soil and must be rotated regularly with other crops. Considerable fruit and many vegetables are grown in the area for use in the cities particularly Louisville. The animal industry, though fairly well developed in connection with the general crop growing of the region, is capable of considerable extension.

The Survey makes a number of general recommendations for the better use of the resources of the region, particularly in the development and practice of agriculture, and points out how the progress and continued welfare of the region may be assured. It concludes by stating that with better roads, growing industries and cities, and rich resources undeveloped the future of the Western Coal

FIGURE 5.—Panorama between Uniontown and Morganfield, Union County, Kentucky, in the Western Coal Field along the Ohio River. The land is almost as level as a lake bed on the Ohio River flood plain. (Courtesy of Kentucky Geological Survey.)

Field, both socially and economically, is bright.

THE KENTUCKY KNOBS

The Kentucky Knobs comprise a belt of conical hills and detached ridges sometimes called "mountains," with a narrow strip of rolling land forming their inner margin which extend in the form of a horseshoe from Vanceburg in Lewis County on the Ohio River near the northeast corner of the state in a roughly crescentic band, nowhere more than 25 miles in width and in most places considerably narrower, about the limestone "Blue Grass Region" to Oldham County, also on the Ohio River near the middle of its northern boundary, a total distance of about 233 miles and a distance of about 103 miles from tip to tip of the crescent. The total area of the Knobs proper is approximately 2,218 square miles. The inner edge of the Knobs is a region of gently sloping hills and ridges with interspersed flat bottom lands bordering the larger creeks, ideal sites for towns because of their relatively level surface, good drainage, and pleasant views; a narrow and comparatively level plateau surface, somewhat dissected by the streams which have easily cut into the shale formation of which it is composed, lies next; and the outermost edge of the Knobs crescent changes into hilly and mountainous topography, "knobby" in appearance and giving the region its distinctive name. These knobs often rise impressively above the foothills; the more isolated knobs rise above a more or less gently rolling peneplain, but along the edge of the higher regions they are more clustered. They vary in height above sea level from 520 to 1,575 feet, and above the land on which they stand from 50 to 900 feet, being highest in the harder Pennsylvanian rocks and lower in the softer Mississippian strata.

The climate is very much like that of the rest of the state, humid and temperate, the difference in elevation and latitude causing only a slight difference from the adjoining regions. The character of the relief is conducive to good air drainage, and determines the sites of the orchards and some of the other crops which are affected by frost.

The resources are dominantly agricultural, even though the soils as a whole are rather infertile and thin. The soils of the lowlands are chiefly alluvial or residual from shale, while those of the highlands are generally light and sandy, easily eroded and quickly depleted of their fertility. The mineral resources are chiefly clays suitable for refractories, brick and tile; gravel and sand and building stone for road and structural purposes; a little coal; several pools of oil of excellent quality and gas; iron ore which is no longer mined; and a few salt wells.

The principal crop grown in all the Knobs counties is corn. Tobacco is the important cash crop. Forage crops are grown practically everywhere and sorghum is widely distributed. Fruits thrive well, and a number of large commercial orchards produce successfully. Irish potatoes are raised in large quantities in one or two counties, and marketing gardens are numerous near the larger towns. The cattle industry though important has not attained the significance that it should have, and dairying particularly will certainly become commercially more important than it is at present.

The life conditions of the Knobs districts are distinctively influenced by the character of the underlying rocks and the soils formed from them. The better farms and more prosperous occupants are found in the more fertile and more level limestone areas along the inner margin of the Knobs and on the uplands underlain by limestone; the poorer farms and the less prosperous farmers are found on the shales and the hilly, stony knobs not underlain by limestone. The fertility of the soil developed from the underlying rocks determines the economic status of the farm and the locality. Railway transportation is adequate for the region and the roads are fairly good and well distributed. River navigation has played and still plays a considerable part in the transportation system. The towns or cities are generally situated at the intersections of highways, and the region is characterized by a large number of clusters of small houses with a store or two and a blacksmith shop where the more frequented roads intersect. No large cities, even moderately large, are found in the section.

The Survey points out that to improve conditions in the Knobs country agriculture must be intensified on the better lands, and silviculture made dominant on the poorer lands. The animal industry must be extended and specialized. Good roads must be built where poor roads now retard development, and the good roads now existing must be improved. The resources in minerals must be scientifically developed and managed. Better schools, better community coöperation, and better utilization of all the native advantages of the region must be achieved, if the region is to keep step with the rest of the state.

THE BLUE GRASS REGION

The Blue Grass, that garden spot of Kentucky, justly celebrated in song and story, is the roughly circular area of rolling upland in north central Kentucky enclosed by the Knobs and the Ohio River. It embraces an area of approximately 8,000 square miles, the eroded crest of a structural dome which gives the region its roughly circular outline, and exposes the phosphatic limestones from which have been devel-

oped one of the richest soils in the world, capable of producing a variety and heavy yield of crops of many kinds.

It is a region of rolling upland with maximum elevation above sea level of about 1,050 feet and a general level of upland between 800 and 900 feet above sea level. The drainage indicates peneplanation, most of the streams meandering in entrenched beds inherited from late Cretaceous valleys; without the shale belt and constituting the outermost section of the Blue Grass lies a more level country, like the inner Blue Grass being underlain with limestones of fairly high phosphorus content.

The mineral resources of the Blue Grass are negligible, the dominant resource of the region being its agricultural adaptability and productivity. The inner and outer Blue Grass belts are characterized by perma-

FIGURE 6.—A Blue Grass pasture in Woodford County, Kentucky, a region as distinctively and naturally rural as any in America, prosperous and patriotic. (Courtesy of Kentucky Geological Survey.)

time. The Blue Grass comprises three concentric belts, the innermost underlain by highly phosphatic limestones having a gently rolling relief except along the larger streams where dissection has carved out considerable hills and also being pitted by sinks and marked by big springs from underground streams; the shale belt which encircles this central limestone area is much more rugged with high hills often terminating in sharp ridges and numerous deep narrow

nence of fertility and of one system of crop rotation into which the same crops fit from year to year, cereals and tobacco alternating with pasture without apparent depletion of soil fertility or the development of excessive erosion. All the land in these belts is cultivated, and is likely to continue under cultivation indefinitely; but in the shale belt between the inner and outer limestone belts where the essential elements for the renewal of fertility are not inherent,

FIGURE 7.—Frankfort in the Kentucky River Valley, a Blue Grass panorama. (Courtesy of Kentucky Geological Survey.)

and where the relief is so considerable as to cause continuous erosion, much of the land would be better given over to silviculture than to cultivation of crops. None of the Blue Grass produces lumber, all the original beautiful hardwood forests which earlier covered it having long ago been cut away.

The outstanding characteristic of the Blue Grass is its dominantly rural composition. Except on the northern margin, no large cities have developed and such increase in population as has marked the region has been largely by increments to the rural class. The rural character of the region is not due entirely to the physical environment, but to a certain extent to the character of the population, a distinctly homogeneous native American type essentially idealistic, democratic, and refined, with means and leisure to indulge in the better things of life. There it is that the art of clean living and high thinking has been best developed, and American home life and hospitality best exemplified.

The Survey considers that the Blue Grass will permanently hold its high place in Kentucky life and in the affairs of the nation, and that no radical changes in the character or quality of occupation or industry are necessary to continue the high standard of life and living which has long been maintained there.

THE PENNYROYAL

The Pennyroyal is a broadly crescentic area surrounding the Western Coal Basin and extending a spur eastward along the Knobs between the Blue Grass and the Mountains. Because of its location and its function with respect to the rest of the regions of Kentucky and the surrounding states, Sauer has designated it the "Corridor." Compared with the surrounding rugged hills and river dissected plateaus the Pennyroyal is smooth and readily passable, and has served as a double corridor leading south from the Ohio Valley and converging upon Nashville, one branch touching the Ohio at Louisville and the other in the area where the Cumberland, Tennessee, Wabash, Ohio, and Mississippi Rivers are nearly confluent. The eastern corridor developed first as an overland route between the Blue Grass and Nashville, while the western corridor was of early importance chiefly as a waterway between the Nashville area and the Ohio River.

Three major natural divisions are distinguished in the Pennyroyal: (1) the Central Pennyroyal with three subdivisions designated the Pennyroyal Plain area, the Elizabethtown Upland area, and the Greensburg Ridge and Valley area; (2) the Marginal areas with five subdivisions designated the Marion Fault Block country, the Northern Clifty area, the Southern Clifty area, the Interfluvial area, and the Mountain Margin; and (3) the Cumberland En-

clave. In addition the "Barrens" are distinguished throughout the region and neighboring states as the native grasslands, which because of their lack of trees were so called by the early settlers, to be changed to "prairies" in Illinois and Missouri. These grasslands of Kentucky were dominantly stretches of blue-stem grass set with a few clumps or groves of trees, and the usual explanation of their origin by fire is accepted by Sauer as adequate.

FIGURE 8.—Northern Pennyroyal or Mississippian Plateau at Big Spring Valley in Meade County, at the northern end of the eastern "corridor" on the Ohio River. (Courtesy of Kentucky Geological Survey.)

On the Pennyroyal Plain the whole of the landscape is occupied by improved farm land with woodland occupying 10 per cent, pasture 20 per cent, corn 30 per cent, wheat 20 per cent, and tobacco 5 to 10 per cent of the typical farm. Tobacco is the chief cash crop, nearly all of it being sold. All the wheat and some of the corn are sold, and a goodly number of cattle and hogs are produced on each farm for sale. On the Elizabethtown Upland the farm land is also nearly continuous, the farms being somewhat larger than on the Pennyroyal Plain and the relative proportions of crops are fairly similar, though on the poorer or more eroded lands cowpeas and soybeans are being grown to replenish the fertility. Log cabins are more common than on the Pennyroyal Plain. In the Greensburg Ridge and Valley area the cultivated land is not so continuous, wooded valleys constituting for the most part the back lots of the farms which front toward the crests of the ridges. Corn is the dominant crop grown in rotation with clover and oats. The farms are generally too small to support their population in reasonable comfort under existing conditions of farming, and the economic system rests upon extreme simplicity of wants and a very large measure of self-sufficiency.

In the Marion Fault Block country with its small, scattered level spaces the large amount of cleared land is impressive, but even so the country

in general has an unkempt, disorderly aspect accentuated by the run-down appearance of the farm buildings and fences and the rough appearance of the uncultivated land largely grown up in briars and brambles, among which Andropogon, locally called "broom sedge," grows rank. More than half the crop land is in corn and much of the rest in red-top hay. Most of the farms have a small patch of sorghum and small uncared-for orchards. Tobacco patches are numerous but small. The farmer's cash income is from cattle and hogs. The sub-marginal character of the land here is indicated by the agricultural decadence and the movement of population to better lands. In the Cliffty areas the undissected table lands support fairly prosperous farms, where tobacco receives the chief attention of the farmer, but the limestone forelands and glades developed at the base of the escarpments and in the larger dolines reveal the final stage of the attempt to utilize sub-marginal lands by the ruined log cabins, old-field timber, ragged remains of fences, and lonely orchard plots where the native shrubs are crowding out the fruit trees.

The Interfluvial area is dominated by forest, with farm lands outlining the dendritic pattern of the drainage and in small measure marking the flats on the upland areas. The thin soil and the heavy erosion have forced a migration of population toward the river margins. Lumbering is the chief industry, and in the little cultivated land corn is the principal crop.

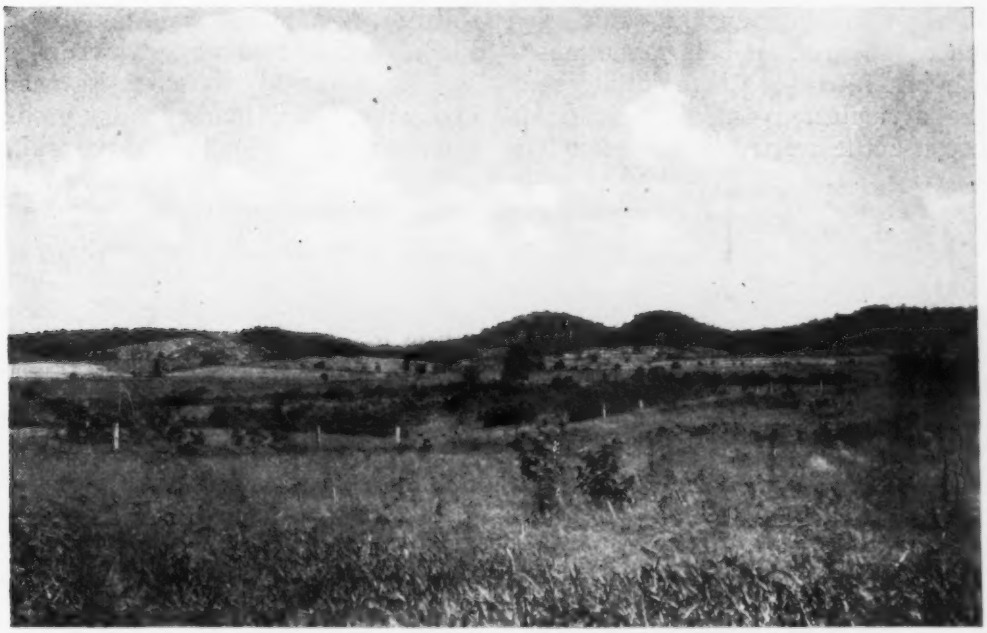

FIGURE 9.—Low rounded hills of southern Crittenden County in the Western Pennyroyal or Mississippian Plateau. The topography of this section is largely due to the differential weathering of the many fault blocks. The ridge in the foreground is capped by a strong sandstone, while limestone surrounds it. (Courtesy of Kentucky Geological Survey.)

The Mountain Margin illustrates the differences between marginal and sub-marginal land. The marginal

land of the limestone piedmont bears farms ample in size, comfortable in appointment, with soil of relatively high fertility, where corn and livestock are produced in ample surplus over the farm needs. The farms are large, of two or three hundred acres, with the farmhouse generally situated where a cool copious spring issues from the base of the escarpment. The sub-marginal land lies in the "breaks" on the ridge tops where the farms are being abandoned, the cultivated area is shrinking, and the agriculture generally decadent, because the relatively thin soil has lost its fertility or been worn down to bed rock.

The Cumberland Enclave offers a contrast to the other areas in that the communities are centered upon the terraces or the colluvial foot of the valley sides near the valley floor. The communities are in general densely settled with a distinct group of people somewhat comparable to the residents of the Blue Grass, quietly dignified and courteous, clear-eyed, soft-spoken, of splendid physique and keen intellect, knowing neither poverty nor wealth. The Flood Plain lands are planted regularly to corn, and yield abundantly, and the corn fields form an unbroken carpet along the river. The lower slopes and terraces are given over to pasture or forage, the soil being somewhat acid. The livestock industry is highly developed and yields the principal income.

Sauer states that the areas of the Pennyroyal which produce a notable commercial surplus are (1) the Pennyroyal Plain and dependent adjacent sections, which specialize in tobacco; (2) the Eastern Pennyroyal Plain, which markets strawberries and livestock; (3) the counties near Louisville, which market dairy products, tobacco, and pork; (4) the Ohio River counties in the west, which have a surplus of cattle and pork; (5) the smooth land in the Greensburg area, producing tobacco in small surplus; and (6) the Cumberland Valley, which sells pigs. The rest of the areas chiefly in eastern counties have no agricultural surplus and almost all the farms are operated by the owners. Everywhere smooth land, and generally fertile land, is indicated by tobacco culture, and in these districts tenancy is highest and the population of negroes the greatest. Corn becomes increasingly significant as the quality of land becomes poorer and the size of farms smaller. Where the land is infertile

FIGURE 10.—Southern Karst area in the Pennyroyal. The Dripping Springs escarpment, looking north from the low sink-pitted limestone area near Bowling Green, Kentucky. (Courtesy of Kentucky Geological Survey.)

and the holdings large, livestock is dominant.

The transportation system of the region both rail and automobile is fairly adequate. The automobile roadnet is a reflection in part of the topography and in part of the cultural and economic status of the regions. The eastern part of the Pennyroyal has the most pressing transportation problems, and Sauer recommends that the old piedmont route be reconstructed and improved as the main artery of communication and transport.

The importance of the county seat in the whole Pennyroyal district is revealed by the fact that in every county, with two exceptions, the county seat is the metropolis; that of the twenty places with more than a thousand inhabitants only three are not county seats. The number of towns is more likely to diminish than to increase, the larger towns of the present attracting people from the smaller; but it is likely that the Pennyroyal will continue as it is now, a serene, rural region set with a few small cities, a number of country towns, and many crossroads hamlets.

SUMMARY

Thus in these six volumes has the Kentucky Geological Survey presented the geographic situation and landscape as it is today, pointing out the relationship between the several factors in the physical and cultural setting and the character and activities of the people. It is an extremely valuable contribution to the literature of geography, and of our land, a contribution which will grow in value and significance as time passes, and opportunity for comparison and observation of progress becomes possible. The economic value of this series of studies to the people of the state of Kentucky cannot be measured in terms of dollars and cents, but certain it is that it exceeds hundred-fold the cost of the Surveys and the publication of the books. If more of the states were to engage in similar exhaustive studies of a general kind, and then to supplement them by such detailed investigation as Michigan is engaged in at the present time with its comprehensive scheme of land surveys, our country would soon have as bases, upon which to build a rational structure of land utilization and industrial development, a mass of authoritative and exhaustive data. The work of the geologic surveys in surveying and appraising the mineral resources of the several states has been exceedingly well done; it is now time to continue their good work by an appraisal of the other equally important resources.

OTHER KENTUCKY SURVEY PUBLICATIONS

It would hardly be just to conclude this review of the work of the Kentucky Survey in the geographic field without calling attention particularly to two other volumes, and generally to the whole series which the Survey has issued. The two volumes which merit particular consideration in connection with geography are "The Topography of Kentucky" by Willard Rouse Jillson, and "Ancient Life in Kentucky" by William Snyder Webb and William Delbert Funkhouser. The latter of these is a thorough discussion of the archaeological material which has been exhumed, collected, and studied, within the state of Kentucky, showing how the pre-Columbian peoples who lived in the state adjusted themselves to the same conditions under

which the present population has made Kentucky what it is. The former constitutes the fundamental data for all the other work in geography and is one of the most critical and comprehensive studies of the relief, drainage, and water supply of a state extant. The study also points out some of the relationships between the topography and the industries and activities of the people.

The whole present series of reports from the Kentucky Geological Survey contains something of geographic significance and indicates how closely the resources of a region may be correlated with its human activities and industries to the best advantage and greatest benefit of its people.

AGRICULTURAL REGIONS OF NORTH AMERICA

Part VI—The Spring Wheat Region

Oliver E. Baker

Economic Analyst, U. S. Department of Agriculture

THE Spring Wheat Region is located in the central portion of the continent, northwest of the Corn Belt, west of the Hay and Dairying Belt, east and northeast of the Grazing and Irrigated Crops Region, and south of the "great northwoods" of the Forest and Hay Region (Fig. 157). It was, prior to settlement, and still remains in the drier portions, a grass-land country, like the Hard Winter Wheat Belt far to the south; also, like the latter, includes both a sub-humid tall-grass and a semi-arid short-grass section. In the sub-humid portion of Canada, and along the eastern margin in Minnesota, the grass land is dotted with aspen groves, but in the semi-arid section trees are found only along the streams or in "wind breaks" planted by the farmers.

The winters are too cold for winter wheat to be grown successfully, except a little in the shelter of the Rocky Mountains, and the summers are too short for corn to mature, except along the southern border; while the lighter rainfall than in the forested country to the east, in conjunction with the colder winters, has retarded the production of the perennial or biennial tame grasses and legumes that constitute the backbone of agriculture in the Hay and Dairying Belt. So the spring-sown grains become the dominant crops, principally wheat, oats, and flax. The normal production of spring wheat is 600,000,000 bushels, 200,000,000 bushels in the United States portion and 400,000,000 bushels in the Canadian. This is about one-seventh of the world's wheat crop and one-half the total production of North America. Barley and rye are less important crops. These five small grains jointly constituted 68 per cent of the crop acreage in 1924 in the United States portion of this region, and about 83 per cent in the Canadian portion in 1926. The moderately dry climate and the fertile black to brown soils, high in nitrates and lime, produce the finest quality of wheat grown anywhere in the world, and the other small grains are also of excellent quality. Hay, mostly of wild grasses and legumes, is the only other important crop, constituting 19 per cent of the crop acreage in the United States portion and about 8 per cent in the Canadian.

The Spring Wheat Region includes nearly all of the prairie portion of western Minnesota north of the Minnesota River; most of South Dakota, excepting the southeastern Corn Belt Section, and the extreme western portion which is either too dry or else too rough and mountainous for crop production; North Dakota, excluding the "bad lands" of the Little Missouri River in the western part; Northeastern Montana and the Piedmont plains lying east of the Rocky Mountains in that

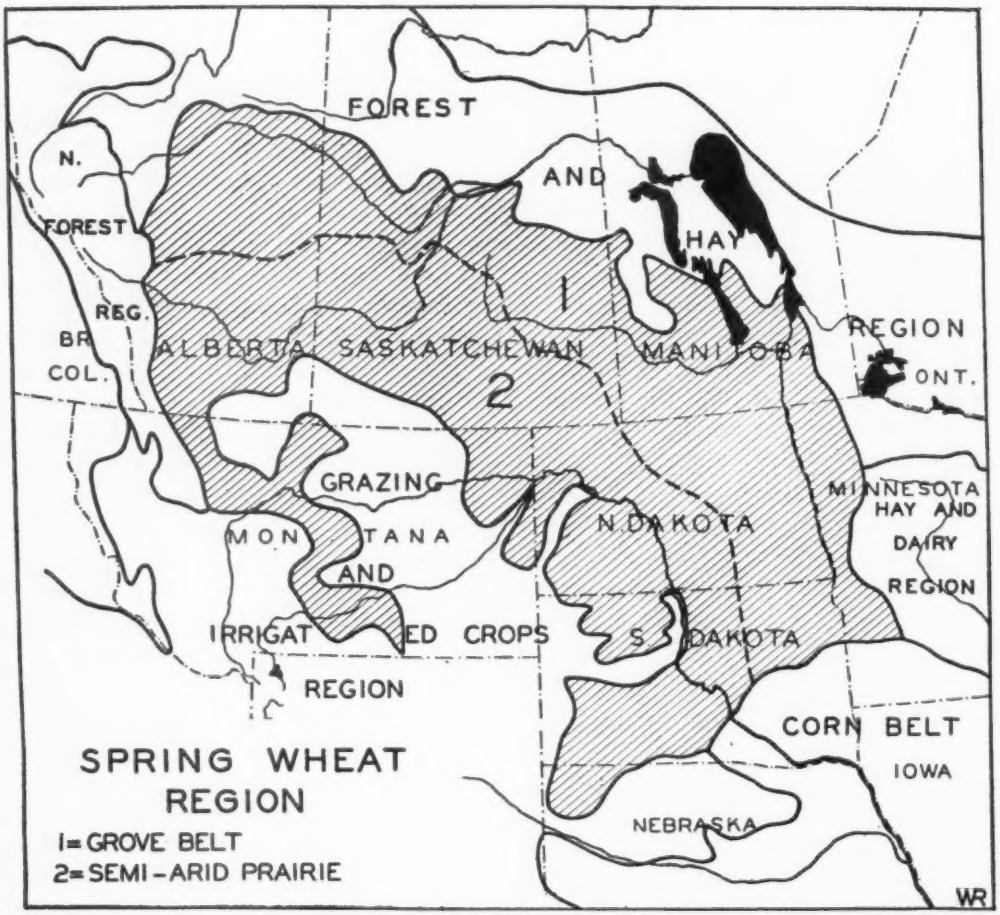

FIGURE 157.—The Spring Wheat Region, which is lightly shaded on this map, is located near the center of the continent geographically, but agriculturally, is the northernmost of the major regions. On the southwest lies the desert, characterized by grazing and irrigated crops. To the northwest, north, and northeast is the "Great North Woods" of the Forest and Hay Region, which can be used for crops only locally and continues to resist settlement. On the east is the beautiful Hay and Dairying Belt, and on the southeast the warm and fertile Corn Belt. The Spring Wheat Region is divided into two parts—a semi-arid section, characterized by short-grass sod much of which has been plowed and put into wheat, while the remainder is used for pasture; and a sub-humid section, characterized by tall grass, with some intermixture of short grass, especially where heavily grazed, and by patches of aspen in the Canadian portion. In this sub-humid section, although wheat is dominant, oats and barley are also extensively grown and much more hay is cut; while dairy cows are more important than beef cattle. The boundary between these two sections is shown on the map by a dotted line.

state; and, most important of all, the prairie and plains portion of Canada, excluding only that area in southwestern Saskatchewan and southeastern Alberta which is too dry for the profitable production of crops. The region is over one thousand miles long (from western Minnesota to beyond Edmonton in Alberta), and varies from 250 to 500 miles in width. It contains an area of about 229,000,000 acres, of which half is in Canada and half in the United States. It has almost exactly the same area as the Hay and Dairying Belt to the east, and is a half larger than the Corn Belt. The 113,400,000 acres in the United States include 6 per cent of the land area of the nation, and the 77,000,000 acres,

more or less, potentially arable constitute about eight per cent of the 973,000,000 acres physically capable of crop production in the United States. It is probable that about 88,000,000 acres of the 115,000,000 acres of land area in the region in Canada are potentially arable. This region contains, possibly, half

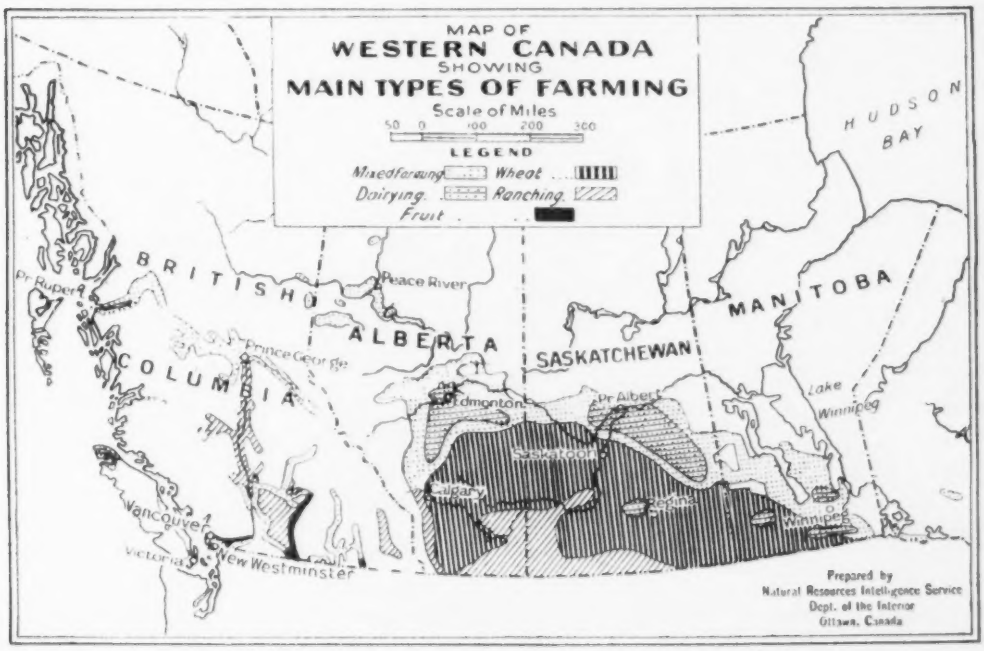

FIGURE 158.—Agriculture in Western Canada is restricted, practically, to the "plains" (originally short grass) and "park" (tall grass with occasional aspen "groves") areas of the Prairie Provinces, with a frontier margin being pressed into the forest region to the north, and to the Valleys of British Columbia. In the "plains" belt of the Prairie Provinces wheat growing is the dominant system of farming, with cattle ranching along the arid margin and on the rougher lands. In much of the "park" belt wheat farming is also dominant, but oats and barley, used largely for stock feed, are of great importance, more hay, mostly wild, is cut, dairy cattle are kept, and the agriculture is becoming "mixed farming." In many localities in this "park" belt, dairying has developed to such an extent that it has become the leading system of farming. (Map from Nat. Res. Int. Service of Canada.)

of the potentially arable land of Canada.

The Spring Wheat Region produced crops in 1924 in the United States portion and in 1925 in the Canadian portion having a total value of about $1,100,000,000, somewhat less than half in the United States and somewhat more than half in Canada. In 1919, however, the United States portion produced more than half the value of all crops in the region. In the United States portion there were 168,000 farms, January 1, 1925, and in the Canadian portion about 205,000 farms June 1, 1926. This Canadian portion contains less than one-third of the farms in Canada, but about two-thirds of the crop acreage of the Dominion. In 1924 the value of crops per farm in the United States portion was about $3,200, and in the Canadian portion in 1925 about $2,700. The average value of the crops per farm was, therefore, a half greater than in the Hay and Dairying Region to the east and four-fifths that in the Corn Belt. The Spring Wheat Region is, in

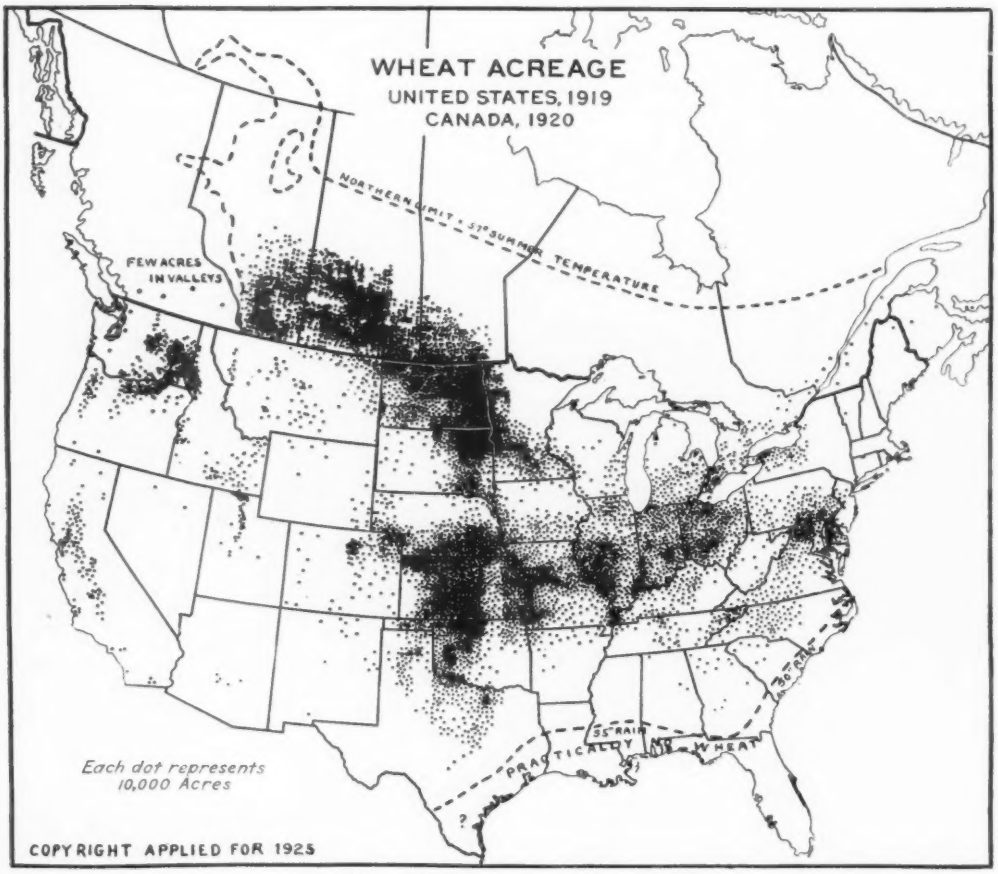

FIGURE 159.—The Spring Wheat Region, extending from eastern South Dakota and western Minnesota to central Alberta, stands out clearly on this map. The season of 1919, however, was very dry, especially in Montana, where only half the wheat seeded was harvested. As the map shows only acreage harvested, this Spring Wheat Region would stand out even darker in a normal season, particularly along the southwestern margin. The average area in wheat in the region, 1921–1927, was about 38,000,000 acres, and production was about 550,000,000 bushels. In the United States portion the average area was 17,000,000 acres, and in the Canadian 21,000,000, while the average production in the United States portion was 200,000,000 bushels, and in the Canadian 350,000,000 bushels. The average yield per acre was, therefore, under 12 bushels in the United States portion, and fully 16 bushels in the Canadian portion of the region. In 1927 production in the Canadian portion was about 400,000,000, and in 1928 probably will be over 500,000,000 bushels.

general, a region of fairly large farms and of efficient farming.

THE PHYSICAL CONDITIONS

The Spring Wheat Region has a "continental" climate, that is, a climate which has a wide annual range in temperature, and is relatively dry (compared with coastal regions), especially in winter. The surface of the land is mostly level to gently rolling, with "breaks" of rough land along the streams, the larger of which have cut deeply into the plains, forming broad and rather shallow canyons. In the drier portions little of the water is available for irrigation, therefore, except near the Rocky Mountains. The soils are mostly fertile, because not leached by winter rains and because of the accumulated humus and nitrogen derived from

the decay of the roots of grasses and leguminous plants during the centuries.

Boundaries

Only the western boundary of the Spring Wheat Region is sharp, where it is limited by the Rocky Mountain front. Even this boundary retreats at places from the mountains, as in northwestern Montana, where the climatic conditions in a small area are too dry for crop production, and in west-central Alberta where the forest intervenes.

The northern boundary is less distinct than the western, but more distinct than the southern or eastern—it is where the forest, either of aspen or evergreens, becomes continuous. Although there are many outlying areas of forest, mostly aspen, in the sub-humid "park" section of the region, and fewer outlying islands of prairie in the Forest and Hay Region to the north, the boundary can be readily traced from near Clyde and Thorhild, 40 miles north of Edmonton, Alberta, eastward a few miles north of the North Saskatchewan River to near Spruce Lake, Saskatchewan, whence it bends southeasterly around the hills to within a few miles of Redberry Lake, and then retreats northeasterly to include Shellbrook. After another southern swing around the Pines Forest Reserve and back to Prince Albert, the boundary trends eastward along the south shore of the Saskatchewan

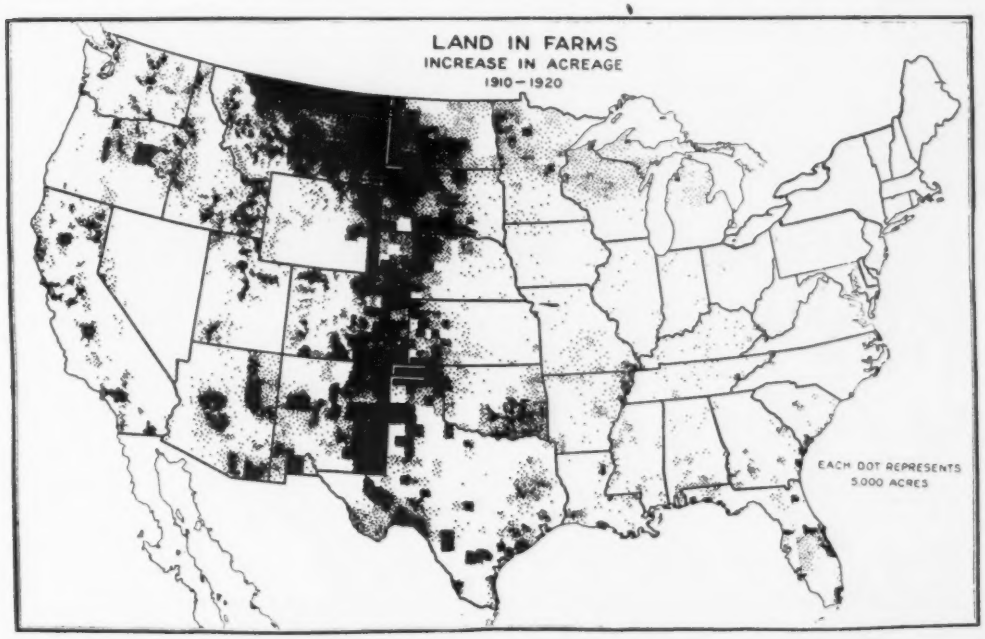

FIGURE 160.—The increase in farm land in the United States between 1910 and 1920 was most notable in the semi-arid section of the Spring Wheat Region. The decade 1880–1890, especially the first five years, witnessed the settlement of the sub-humid section of the region in the eastern Dakotas, and it was nearly a quarter century later before the drier lands, lying west of the Missouri River in the Dakotas and extending westward into Montana, were occupied by homesteaders, as is shown on the map above. This influx diminished rapidly after 1916, each year afterward becoming drier until 1919. Since that calamitous year, especially in Montana, climatic conditions have greatly improved; nevertheless, the number of farms has decreased, and crop land (including crop failure) has remained stationary. (Map from U. S. Dept. of Agr.)

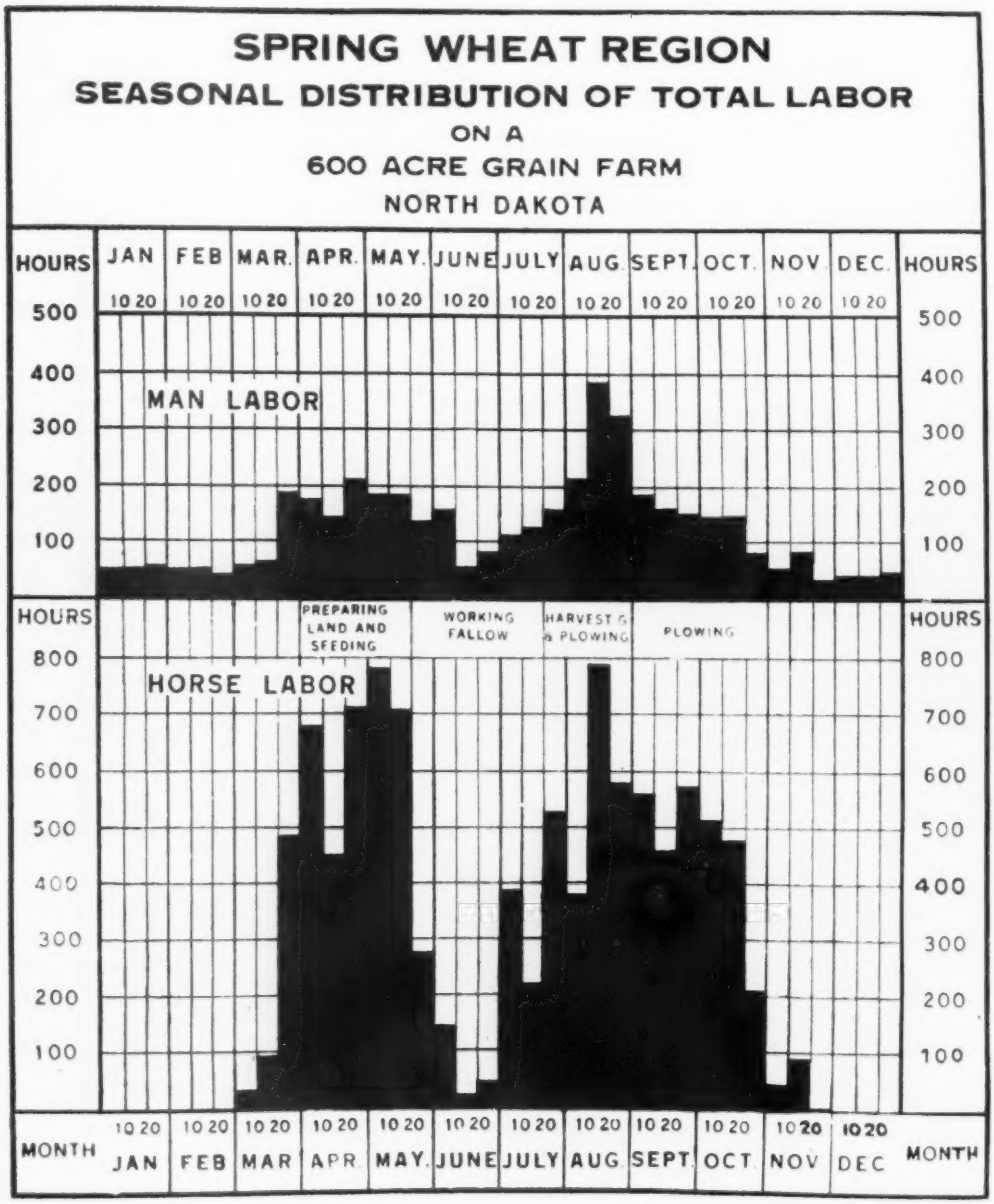

FIGURE 161.—In the Spring Wheat Region the heaviest demand for man labor comes at harvest time, which occurs in August in the United States portion of the region, and in September in the Canadian portion. An earlier peak load of labor, less accentuated, but of longer duration, occurs during April and May, when the preparation of the land and the seeding, first of wheat and then of oats, barley, or flax, takes place. In winter there is not much to do, nor in early summer. One of the greatest incentives to the development of dairying in the region is the fact that it affords profitable employment during the winter and helps to smooth out the seasonal distribution of labor.

On the North Dakota farm for which the seasonal labor is shown in the graph above, there were 280 acres of spring wheat, 127 acres of oats, 60 acres of barley, 49 acres of flax, 20 acres of hay, and 52 acres fallow. Two brothers did all the work except during the harvesting and threshing season, August 1 to September 10, when one to three day laborers were employed. In this area it is customary to hire the threshing done, and this labor does not appear on the graph. (Graph from 1917 Yearbook, U. S. Dept. of Agr.)

River, to the longitude of 104, where it turns south for 40 miles, and then curves southeasterly and easterly, crossing into Manitoba near latitude 52. After swinging around the Swan River Prairie, the boundary continues southeasterly around the edge of the Duck and Riding Mountains and then turns back to include the Dauphin Prairies on the eastern side, whence it trends southeast again to the southern end of Lake Winnipeg.

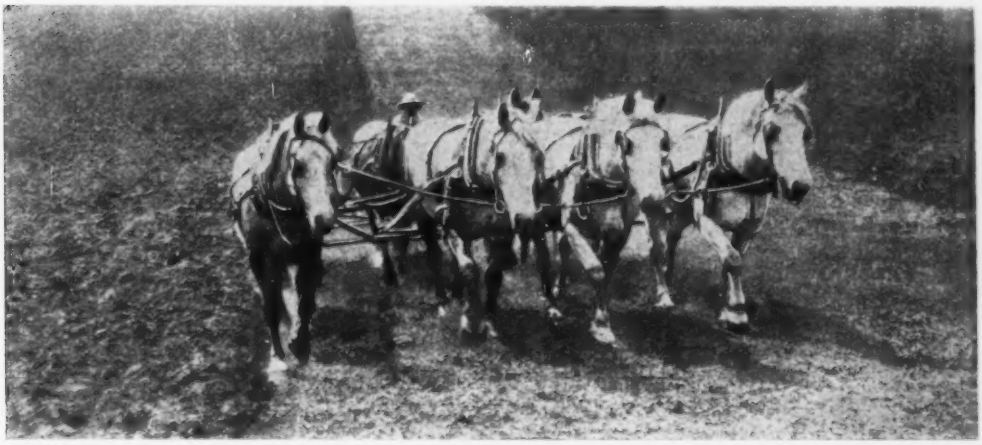

FIGURE 162.—Plowing for wheat. The power available on farms in the United States and Canada, including both animal power and that supplied by mechanical engines, is much greater than that available in all the factories of these nations. Plowing, particularly, involves the use of a large amount of power. The plowing, 6 inches deep, of 260 acres of land, the average area in crops per farm in North Dakota, involves the movement of over 300,000 tons of earth, and the distance travelled, using a single 12-inch plow, would be over 2,000 miles. Hence, the need of using 2- and 3-bottom plows on these large farms, which reduces this distance to be travelled to a half or a third. A single plow drawn by two horses at two miles an hour would require over 100 days of ten hours each to plow 260 acres, but a 3-bottom plow, which is probably the size shown in the picture, drawn by eight horses at two and one-half miles an hour, would require only 28 working days. To spade such 260 acres by hand—or perhaps we should say by foot—would require 13 years of 300 working days each. (Photo from Nat. Res. Int. Service of Canada.)

The eastern boundary follows along the eastern edge of the Red River Valley, crossing into the United States about 25 miles east of Emerson, and continues southward to the Minnesota River near Redwood Falls. This eastern boundary at present corresponds in general with the eastern margin of the prairies. Timothy and red clover, the great hay crops of the Hay and Dairying Region to the east, are successfully grown throughout the Red River Valley, and dairying is rapidly developing in the valley; consequently the crops grown and the system of farming in the Red River Valley, the former heart of the Spring Wheat Region, may some day justify its inclusion with the Hay and Dairying Belt to the east. Indeed, dairying may eventually become the characteristic industry throughout the sub-humid, "black-earth," tall-grass section of the present Spring Wheat Region, that is, in the James River Valley, and as far west as Minot and Portal, North Dakota, Indian Head and Saskatoon, Saskatchewan, and as far south in Alberta as Provost, Castor, and Olds.[1]

[1] See dotted line in colored map of Agricultural Regions of North America, frontispiece to October, 1926, issue of ECONOMIC GEOGRAPHY.

On the southeast the Spring Wheat Region adjoins the Corn Belt. The boundary is drawn where the production of corn exceeds 3,000 bushels per square mile. Beyond this line the number of hogs and beef cattle increases rapidly. Like dairying on the east, the Corn Belt system of farming has been encroaching on the Spring Wheat Region, the advance having been about 50 miles during the past decade. But, unlike dairying, it seems that this Corn Belt system of farming has almost reached its climatic limit because of the short season and relatively cool summer weather.

FIGURE 163.—Harrowing for wheat. This picture, taken in Alberta, shows a steam tractor dragging four disk harrows, followed by a spike-toothed harrow, preparing plowed land for seeding. If a gasoline or oil tractor were used, one man could do the work instead of two. (Photo from Nat. Res. Int. Service of Canada.)

The arid southwestern boundary of the Spring Wheat Region is least definite of all. It is drawn where the value of the pasturage exceeds the value of the crops. Along the Nebraska Sand Hills the line is distinct, and also along the Black Hills in western South Dakota; but to the north and south of the Black Hills and throughout practically the entire length of the boundary in Montana, southwestern Saskatchewan, and southeastern Alberta, the boundary tends to advance in a series of wet seasons, or a period of high prices for wheat, and to retreat when a series of droughts occur, or when prices are low. However, the range of movement is no longer wide and a stability in system of farming appears to be approaching at about the boundary line shown on the map.

Climate

The climate of the region ranges from humid along the eastern and northern boundaries to arid along the southwestern, that is, from a boundary where there is sufficient

FIGURE 164.—Seeding wheat. This is an unusual scene, most farmers in the Spring Wheat Region using only one seeder, like any of those shown in the picture. The photograph was taken on Rudd's farm, near Rocky Ford, Alberta. Note the level land and the low hills in the distance—characteristic Spring Wheat Region topography. (Photo from Nat. Res. Int. Service of Canada.)

rainfall to leach entirely through the soil and form a water table to a boundary where there is not sufficient rainfall for production of the most drought-resistant crops, which in this region are wheat and wild hay. Along the humid margin the native tall grasses give place to continuous forest, and a little beyond the arid margin the short grasses (*grama* mostly) give place to sage brush in the river valleys of Montana.

FIGURE 165.—Harvesting wheat. After the wheat is seeded there is little to be done until it is harvested. This picture, taken near Saskatoon, Saskatchewan, shows a steam tractor pulling four binders. Today a gasoline tractor probably would be used instead, and the binders would be replaced by a combine. (Photo from Nat. Res. Int. Service of Canada.)

From this moisture standpoint, the region, as already noted, is devided into two sections, a sub-humid and a semi-arid. The sub-humid section is characterized by black or dark chocolate-colored soils and by tall-grass natural vegetation, with patches of aspen dotted over the prairie in the Canadian portion, and also in a narrow belt along the eastern margin of the region in Minnesota. In much of this sub-humid section timothy, brome grass, and the very promising sweet clover can be grown successfully, as well as the small grains; consequently the trend is toward dairying and general farming. In the semi-arid section, timothy cannot be grown, and brome grass and sweet clover are grown only sparingly; consequently the small grains, wheat principally, seem likely

FIGURE 166.—Threshing wheat. After the wheat is cut with a binder it is piled on a broad-boxed wagon and carried to the threshing machine. This picture, taken in Manitoba, shows these wagons loaded with the bundles of wheat, which are being thrown into the threshing machine (almost concealed behind one of the wagons), the gasoline tractor with belt connecting with the threshing machine, a wagon drawn up beside the threshing machine into which the sacks of wheat are being loaded, and the pile of straw, which will be burned later. (Photo from Nat. Res. Int. Service of Canada.)

to persist as the all-important crops, supplemented by wild hay and, in the United States portion, by corn for forage or silage.

The average annual precipitation along the humid margin of the Spring Wheat Region increases from 15 to 16 inches along the northern border in Canada to 22 inches in northwestern Minnesota, and 26 inches in the Minnesota River Valley, where the summer temperatures are much higher and the evaporation greater. Along the shorter arid margin the annual precipitation increases from 13 inches in north-central Montana to 15 inches in western South Dakota. The intermediate line separating the subhumid, originally tall-grass, section from the semi-arid, short-grass section corresponds with about 15 inches annual precipitation in Canada, 17 inches in central North Dakota, and 20 inches in east central South Dakota. Throughout the Spring Wheat Region from 70 to 80 per cent, or more, of the annual precipitation occurs during the six warm season months, April to September inclusive, and 40 to 50 per cent during June, July, and August.

This concentration of rainfall in late spring and summer is favorable to the production of annual plants, like the small grains; but the cold, dry winters are very hard on all perennial plants, such as the tame hays, and make the production of orchard fruits almost impossible. Toward the arid margin of the region the uncertainty of the rainfall, which varies greatly from year to year, makes the production even of the small grains precarious; consequently, in addition to the usual acreage in grain, a large acreage is allowed to remain in native pasture, as insurance against drought and because the sale of cattle supplements greatly the farm income. Forage crops, principally corn and sunflowers, also are grown by many farmers, and stored in pit silos dug in the ground against the dry year, or for use in the winter.

The difference in temperature between winter and summer, like that in precipitation, is very great. The winters in the United States portion are the coldest in any part of the nation, but the summers are as warm as along the coast of southern California, or in Michigan and New

FIGURE 167.—Harvesting wheat with a combine. This picture shows the latest method of harvesting wheat. The combine, which is being drawn by a tractor, cuts, threshes, and cleans the wheat of weed, seeds, and dirt, and either bags the cleaned grain or else pours it into a tight box-wagon. The outfit pictured above requires only two men to operate, one to run the tractor and the other to operate the combine. These small combines are enabling the farmers of both the Spring and Winter Wheat Regions to harvest and thresh their wheat often without hiring additional labor, and do it rapidly when it needs to be done. In the illustration the wheat is not being cut, but a pick-up attachment is cleaning up some wheat that has been cut and left on the ground. (Photo from Nat. Res. Int. Service of Canada.)

England. The average summer (June, July, and August) temperature along the northern margin of the region in Canada is about 59 degrees. The summer temperature of 57 degrees is about the absolute northern limit for wheat (Fig. 159). The July temperatures along the northern margin of the region average 63 degrees, whereas the January temperatures average about 10 degrees below zero. Along the southern boundary the average July temperature is from 60 to over 70 degrees, and the January temperature 10 to 20 degrees above zero. Temperatures as low as 60 degrees below zero have been recorded in the American as well as Canadian portion of the region, and temperatures as high as 105 degrees in the Canadian and 110 degrees in the American portion. This extreme range of 170 degrees exceeds any recorded elsewhere in North America.

The duration of the frost-free season is another climatic measurement of great agricultural significance. Along the southern margin of the region the average frost-free season ranges from 120 days in Montana to 140 days in part of South Dakota and Minnesota; while along the northern margin in Canada it averages 90 to 100 days. The seeding of spring wheat is generally two to three weeks before the average date of the last killing frost in spring; and harvest is generally in the Dakotas a month before the first killing frost in autumn; but along the northern margin of the region in Canada frost sometimes occurs before the wheat is harvested, indeed, some years snow has fallen before the wheat was ripe. However, even along this northern margin the wheat matures and is harvested before frost in about three years out of four.

Topography

The Spring Wheat Region is a plains or steppe area, much dissected in the semi-arid section, and has, in general, an almost imperceptible slope to the east. The Red River

Valley and most of North Dakota east of the Missouri Coteau, as well as nearly all the Canadian portion of the region, drains east and northeast into Hudson Bay, while the southern and southwestern margin drains east into the Missouri River. In the sub-humid section nearly all the land, except the "breaks" along the river valleys, is level or gently rolling, and well adapted to the use of farm machinery; but in the semi-arid section many of the streams, especially in the western part of the Dakotas and in Montana, have cut deep valleys, and the margins of these stream valleys are usually very broken, sometimes deserving the term "bad lands." These "broken" areas commonly extend up the branches of the streams, and the erosion is so extensive that only a little over half of the land in the United States portion of the semi-arid section is sufficiently smooth for crop production. In addition, much of the morainic belt that crowns the Missouri Coteau in the Dakotas, as well as a belt of broken country in southern Saskatchewan, including "Wood Mountain" and the "Cypress Hills," are too rough for crop production. There is a notable difference, therefore, in the topography of the sub-humid and semi-arid sections. Probably no other agricultural region of North America, except, possibly, the Corn Belt, and the Winter Wheat Region to the south, possesses so large a proportion of topographically arable land as the sub-humid section; and, by contrast, few non-mountainous areas possess so much rough land as the semi-arid section in the United States and southwestern Saskatchewan. There are no mountains in the region, and the few hills are mostly flat-topped erosional remnants called "buttes."

FIGURE 168.—Loading wheat. It is more common in the Spring Wheat Region to pour the wheat from the threshing machine (separator) directly into a tight wagon-box than to sack it as shown in Figure 166. This picture shows the wheat pouring from the separator into the wagon-box. (Photo from Nat. Res. Int. Service of Canada.)

Soils

The rainfall in nearly all the region is not sufficient normally to percolate entirely through the soil, and on undisturbed, level areas carries down lime and other soluble material to the depth of its normal penetration. As the depth of this layer of lime accumulation varies more or less directly with the amount of rainfall, a means is provided of measuring, with surprising accuracy, the normal annual precipitation. Along the humid (forest) margin of the region, this whitish layer of lime accumulation (which effervesces on application of acid) begins to appear at a depth of 4 or 5 feet; half way across the sub-humid, tall-grass section, it has risen to only 2 or 3 feet below the surface. Where the tall-grass and the short-grass overlap, it is usually about 18 inches deep, while at the desert edge, where crops cannot be grown profit-

ably in the average year, this layer is only 6 to 9 inches beneath the surface, and in alkali spots occurs actually at the surface. The color of the soil is another criterion of available moisture. It is black or nearly black in the sub-humid or tall-grass section, except under the aspen groves, or where there is other forest vegetation, changes to deep chocolate-brown along the margin of the semi-arid, short-grass section, is medium brown in the middle of this semi-arid belt, and becomes light brown along the desert edge where crops can no longer be grown.

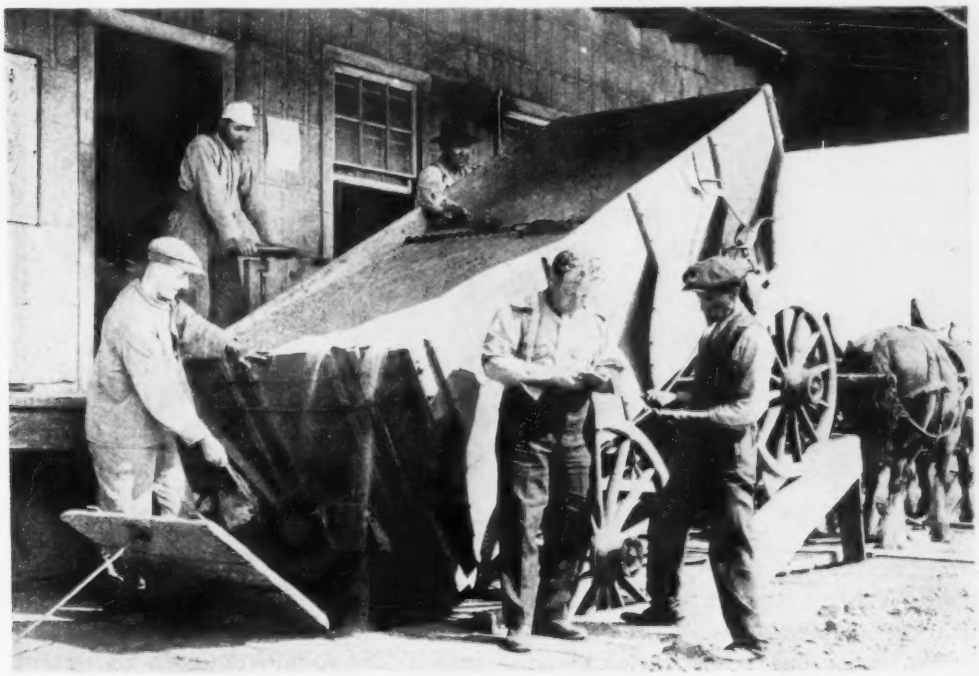

FIGURE 169.—Unloading wheat at elevator. The wagon loaded with wheat is hauled onto a tilting platform at the elevator, the front tilted up, the end gate opened, and the wheat poured onto an endless belt which carries it into the elevator, where it is elevated by similar belts carrying buckets into one of the bins. (Photo from Nat. Res. Int. Service of Canada.)

The soils in the Spring Wheat Region are derived principally from limestone and shale, more or less mixed during glaciation, and are very fertile, except where sandy, or alkaline, or poorly drained. The soils are especially high in nitrates, lime, and potash. The frozen condition of the soil during the long winter, as well as the light winter precipitation, prevents the leaching of these mineral salts from the soil at this season of the year, and the luxuriant growth of the native grasses and flowering plants have exerted a similar influence during the summer season. In addition, the decaying roots of the grassland vegetation have added humus to the soil, and this humus has promoted an excellent tilth or texture, even in some of the heaviest soils. The amount of humus is less in the brown-earth than in the black-earth section; and in places in this brown-earth belt, especially near the arid margin, so-called "hogwollows," or spots almost bare of vegetation, occur, in which the tilth of the soil is

destroyed, probably by the action of soda. Such soils are very intractable. Most of the soils of the region are dominantly of silty texture, some clayey. On the whole, there is no agricultural region in North America, except the central and western Corn Belt, that has better soils.

The high fertility of the unleached soil, however, is about balanced by frequently deficient rainfall, especially in the semi-arid section, and by the occurrence of early frost some years, which in Canada is more frequent in the colder, sub-humid section. Although the region is subject to alternating periods of prosperity and depression, according to the seasonal conditions and the price of wheat, with the accumulation of capital and the development of dairying, more particularly in the sub-humid portion, it will become one of the richest, as it is already one of the most productive, per capita of the agricultural regions in North America.

LAND UTILIZATION

The agricultural development of the Spring Wheat Region was rapid, the prairie sod needing only breaking to be ready for flax or wheat, and the railroads pushed ahead of settlement and provided a ready means of bringing in supplies and of sending out grain. Nevertheless, the movement into the United States portion proceeded, by waves advancing from east to west, the increasing aridity toward the west retarding crop production until improved methods of dry farming and farm organization were worked out. Then, a few wet seasons, widely advertised by the railroads, would induce settlement; while the dry years, which always follow, would sift out the less fit. The first major wave came into the eastern portion of the Dakotas during the years 1878–1885 and was followed by an ebb as a result of several dry seasons. Other waves followed, each extending farther than the preceding. During the latest wave, in the years 1913–1916, the homesteaders dispossessed the cattlemen along the arid margin of the region in Montana and the western Dakotas. The unprecedented series of dry years, 1917–1920, caused a vast exodus, especially in Montana, and even in the entire United States portion of the region the number of farms declined between 1920 and 1925. But, the crop acreage has been fairly well maintained, and there will be probably a gradual increase for two or three decades, especially if more farmers find the means to purchase tractors and combines (Figs. 160 and 161).

FIGURE 170.—Elevators at Virden, Manitoba. The elevator adjoins the railroad siding, and the wheat is allowed to flow by gravity through the spout that can be faintly seen in the picture, into the freight car, which has been made tight, so no wheat will be lost in transit. (Photo from Nat. Res. Int. Service of Canada.)

In the Prairie Provinces the first wave of settlers (other than the fur traders who had been in the region for a century) moved into Manitoba in the sixties and seventies, occupying the wooded river margins in western Manitoba and extending

settlement into what is now eastern Saskatchewan. In 1875 the first Mennonites settled on the open plains and demonstrated that the prairies could be farmed. This date marks the beginning of a new epoch. In 1881 the construction of the Canadian Pacific west from Winnipeg began, and by 1883 the railroad had been built entirely across the plains to Calgary and the Rocky Mountains. A rush of settlers followed, but results were disappointing, owing to an unwise land policy. From this time settlement followed the railways, which were built rapidly throughout the region, as well as the rivers, and came in waves as in the United States portion of the region. However, unlike the United States portion, the grain farmers did not find cattle ranchers occupying the land, but both came in together, the grain farmers occupying the smoother or moister lands and the ranchers the rougher and more arid. The early settlers were mostly Canadians, "Americans," and British. In 1897 the Ruthenians began to come and the Germans and Doukhobors a few years later. Today, the immigrants from Continental Europe constitute fully half of the total.[2]

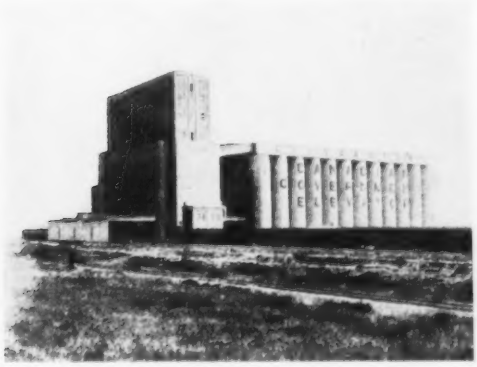

FIGURE 171.—The wheat may be carried by the railroad to a large elevator, like this at Saskatoon, for storage; or it may be hauled direct to the terminal elevators at Fort William, Fort Arthur, or Duluth, near the western end of Lake Superior, or at Minneapolis, Minnesota, or at Vancouver on Puget Sound. Formerly, nearly all the wheat went east to the Lake Superior ports, or to Minneapolis, but now much of the Alberta wheat is being shipped west over the Rocky Mountains to Vancouver, where it is transferred to steamers going to the Orient or to England via the Panama Canal. (Photo from Nat. Res. Int. Service of Canada.)

By 1921 the occupation of the Canadian portion of this region, so far as number of farmers is concerned, appears to have been almost complete, there having been a decrease of over 7,000 farmers in the Prairie Provinces, mostly in Alberta, between 1921 and 1926 (Table I). Although the number of farms (or farmers) is decreasing in most parts of the Prairie Provinces, the crop area, as in the United States portion, continues to expand. The increase in the Prairie Provinces between 1921 and 1926, mostly in the Spring Wheat Region, amounted to 2,627,000 acres, or over 8 per cent (Table I). In the Dakotas and Montana, the increase in acreage of crops harvested between 1919 and 1924 was 3,536,000 acres, or 9 per cent; but after allowance is made for crop failure in 1919 a small decrease is indicated. In 1919 the very dry season caused an unprecedented acreage of crop failure in these states. In Montana the acreage of crops not harvested because of crop failure was equal to the acreage of crops harvested. This is an extreme instance, but it illustrates the uncertainty of crop production in the semi-arid section of the region.

Influence of Agricultural Machinery

Crop production in this semi-arid section owes its existence to the development of agricultural machinery

[2] For most of the data contained in this paragraph the writer is indebted to Professor D. McArthur of Queens University, Kingston, Ontario, Canada.

TABLE I

SPRING WHEAT STATES, 1880–1925, AND PRAIRIE PROVINCES, 1881–1926

(Number of Farms, Total Acreage of Crops Harvested, and Acres of Crops Per Farm)

Farms	Year Crops	*Total—Three States* Farms Number	Crops Acres	Crop Acres Per Farm	*South Dakota* Farms Number	Crops Acres	Crop Acres Per Farm
1880	1879.....	18,954	742,761	39	13,564	508,816	37
1890	1889.....	83,372	9,886,383	119	50,158	5,648,537	112
1900	1899.....	111,324	17,829,231	160	52,622	8,851,823	168
1910	1909.....	178,218	30,039,779	169	77,644	12,285,577	158
1920	1919.....	210,004	38,604,642*	183*	74,637	15,070,352*	202*
1925	1924.....	202,411	42,141,146	208	79,537	15,771,943	198
		North Dakota			*Montana*		
1880	1879.....	3,871	133,219	35	1,519	100,726	66
1890	1889.....	27,611	3,806,061	141	5,603	381,785	68
1900	1899.....	45,332	7,821,917	172	13,370	1,155,491	86
1910	1909.....	74,360	15,877,731	214	26,214	1,876,471	71
1920	1919.....	77,690	19,633,837*	253*	57,677	3,900,453*	68*
1925	1924.....	75,970	19,955,376	263	46,904	6,413,827	137

* The season of 1919 was very dry. There were 4,331,000 acres of crop failure in Montana, 2,140,000 in North Dakota, and 819,000 in South Dakota, a total of 7,290,000 acres, as compared with 977,000 acres in 1924 (347,000 in South Dakota, 322,000 in North Dakota, and 308,000 in Montana). If crop failure were included; the acreage in crops in Montana, and North Dakota would be greater in 1919 than in 1924.

Year	*Total—Three Provinces* Farms Number	Crops Acres*	Crop Acres Per Farm	*Manitoba* Farms Number	Crops Acres*	Crop Acres Per Farm
1881.....	10,042**	251,142	25	9,077**	230,264	25
1891.....	†	1,415,000‡	...	†	1,225,000‡	...
1901.....	55,176	3,600,119	65	32,252	2,756,106	85
1906.....	122,398	8,407,697	69	36,141	4,220,161	117
1911.....	199,203	17,677,091	88	43,631	5,161,858	118
1916.....	218,563	24,595,915	112	46,580	5,116,661	110
1921.....	255,657	31,998,970	125	53,252	5,857,635	110
1926.....	248,162	34,626,474	139	53,251	6,261,417	118
	Saskatchewan			*Alberta*		
1881.....	704**	13,263	19	261**	7,615	29
1891.....	†	157,000‡	...	†	33,000‡	...
1901.....	13,445	655,537	49	9,479	188,476	20
1906.....	55,971	3,271,436	58	30,286	916,100	30
1911.....	95,013	9,136,868	96	60,559	3,378,365	55
1916.....	104,006	13,973,382	134	67,977	5,505,872	81
1921.....	119,451	17,618,145	147	82,954	8,523,190	103
1926.....	117,781	19,198,357	163	77,130	9,166,700	119

* Excluding wild hay. ** "Occupiers of land"—apparently farm lands only. † Not given in census. ‡ Acreage of minor crops not given, estimated on basis of production.

and railroad transportation. The plow, the grain-binder, and the threshing machine have made it possible for one man to cultivate 25 to 50 times as large an acreage as he could with the primitive tools in use in the United States a century ago and still used in the Orient. In China such semi-arid land is not cultivated, because a man can spade or hoe up in time for seeding only about 4 acres, which at 8 to 10 bushels of wheat per acre will scarcely more than half suffice to feed a family a year. Even in the moister areas in China much land is left idle because of the variable rainfall and poor transportation facilities that prevent the importation of food in years of famine.

The utilization for crop production of the fertile soil of the Spring Wheat Region, and of similar regions in other parts of the world, is in some ways the greatest triumph of our mechanical age; and each advance in the application of power to agriculture gives an added advantage to these level lands of the Northwest. The tractor and the combine now bid fair to double the acreage of grain that a farmer can handle in this region. In consequence it appears

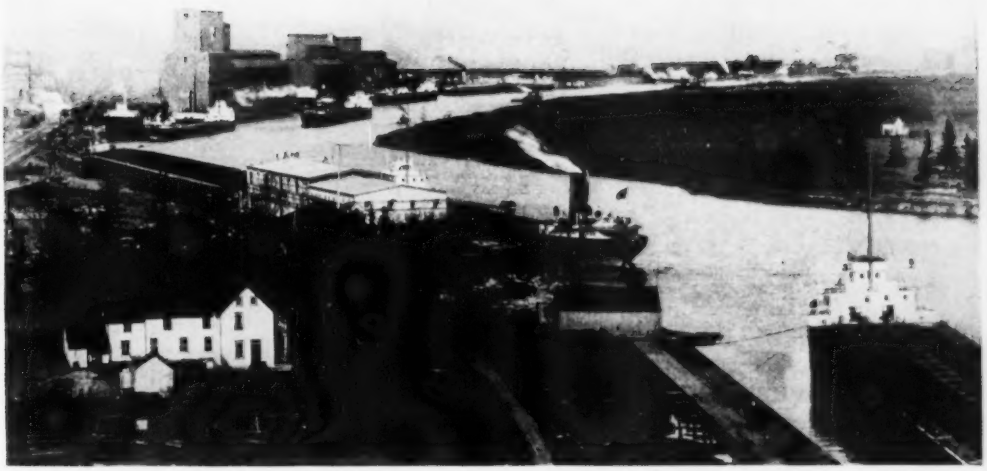

FIGURE 172.—Fort William, Ontario. Most of the Canadian wheat moves by railroad to Fort William—Port Arthur on the north shore of Lake Superior, where it is transferred to elevators with large storage capacity. The elevators may hold the wheat only a few hours or many months, depending on the price of wheat and shipping conditions. The elevators transfer the wheat by means of endless belts, to the lake boats and these carry it across Lake Superior through the Soo locks, and then on to Georgian Bay ports, or else to Buffalo and other ports on Lake Erie. From Georgian Bay ports most of the wheat is carried by the railroads to Montreal, where it is transferred to steamships for shipment to Europe. From Buffalo the grain is carried by railroads, or by the Erie Canal to New York City, or by railroads to Philadelphia and Baltimore, where it is transferred through elevators to steamships bound for Europe, principally England, the Netherlands, and Italy. (Photo from Nat. Res. Int. Service of Canada.)

likely that not only further extension of the margin of cultivation and increase in cultivated land will occur, but also rural depopulation in those areas where dairying and other more intensive systems of farming do not develop. It is possible that the expansion in crop acreage will occur more rapidly than the increase in individual efficiency, and thus prevent rural depopulation in the region as a whole, for a while, but this is doubtful.

Possibilities of Extension of Crop Area

There is, however, as previously indicated, still a large opportunity for agricultural expansion. Only 33 per cent of the United States portion of the region was in crops in 1924, or 34 per cent if crop failure be included, and 30 per cent of the Canadian portion in 1926 (including wild hay). However, as about three-fourths of the land in the Canadian portion of

the region is potentially arable, and only a little over two-thirds in the United States portion, it appears that 40 to 50 per cent of the physically available crop area in the region is in crops at present. Since much of the land included as potentially arable is dry "grazing-forage-crop-land," of which very little is ever likely to be used for crops, it is probably truer to conditions to say that from half (in Canada) to two-thirds (in the United States) of the potentially arable land is cultivated at present. This 50 to 60 per cent of the potentially arable area in the entire region that is in crops at present may be compared with 50 per cent in the Hay and Dairying Region to the east, 80 per cent in the Corn Belt, and 40 per cent in the Cotton Belt.

FIGURE 173.—Homesteads in western South Dakota. This picture shows the first stage in the agricultural settlement of the Spring Wheat Region. Note the sod piled around the "shacks" to keep out the cold winds. (Photo by J. S. Cotton, U. S. Dept. of Agr.)

It should be realized that practically all the best land in the United States and Canada, most of the good land, much of the fair land and even some poor land is already in cultivation, and that land which remains uncultivated is of such quality that it does not pay to cultivate it at the present price of farm products. Millions of acres of land in both nations that have been cultivated are going back to grass or forest at present. In 1926 there were in the three Prairie Provinces over 19,000 vacant or abandoned farms, having a total area of 4,000,000 acres, and it is probable that there were fully as many in the United States portion of the Spring Wheat Region.

In the Canadian portion of the region, over 35 per cent of the land area in the semi-arid "prairie" section was in crops in 1926, and less than 27 per cent in the moister subhumid "grove" section. In the American portion of the region only 21 per cent of the land area in the semi-arid, short-grass section was in crops in 1924, but over 58 per cent in the moister, tall-grass section. This marked contrast in land utilization conditions between the Canadian and United States portions of the region is owing primarily, in the semi-arid section, to the much greater proportion of rough land in the United States portion than in the Canadian. A preliminary tabulation of land classification data indicates that nearly half of the land in the semi-arid section in the United States is too rough or broken for crops, and after allowance is made for very

FIGURE 174.—A house, barn, and outbuildings. The erection of a two-room house and a barn, and the plowing of a few acres of land marks the second stage of settlement. (Photo taken near Plentywood, Montana, by L. A. Reynoldson, U. S. Dept. of Agr.)

droughty or sandy areas, that only about 45 per cent of the land is available for crop production. In the Canadian portion of the semi-arid section, on the other hand, it seems probable that nearly 70 per cent of the land is potentially arable.

In the sub-humid, tall-grass section the reverse situation appears, the soil surveys indicating that only about 5 per cent of the land in the United States portion is too rough or sandy for crop production, whereas, in the Canadian portion the estimates indicate that nearly 20 per cent of the land is not tillable. It appears, therefore, that in the United States over 60 per cent of the potentially arable land in the sub-humid and only 36 per cent in the semi-arid section is in crops at present; whereas in Canada only about 33 per cent of the potentially arable land in the sub-humid section and 48 per cent in the semi-arid section is in crops.[3] This surprising fact revealed by the census statistics corresponds with observations while on trips through the region, and is owing probably in part to the cost of clearing the aspen groves in the moister section of the region and in part also to the development of dairying, with the resultant tendency to make greater use of the natural grassland for pasture than in the semi-arid section (Table II).[4]

The Crops

Because of the cold, dry winters and short, frost-free season, grain crops, which are seeded in the spring and harvested in the late summer or

[3] For the estimate of potentially arable land in the prairie portion of Canada the writer is indebted to F. A. Wyatt and A. H. Joel, chiefs of the soil surveys in Alberta and Saskatchewan respectively, and to R. W. Murchie of the Manitoba Agricultural College, author of the notable monograph, "The Unused Lands of Manitoba," published by the Manitoba Department of Agriculture and Immigration in 1926. In the United States the estimates for the sub-humid section are based on the tabulation of data contained in fifteen county soil surveys so far made in eastern North Dakota and South Dakota, which appear to be representative of the entire sub-humid section; and in the semi-arid section are based in part on a preliminary tabulation of data secured by the United States Geological Survey from reports on applications for entry under the Grazing Homestead Act and from county tax records. The writer is deeply indebted to W. H. Hopper, of the United States Geological Survey, for the generalized results of this tabulation. As the area covered by the Land Classification work of the Geological Survey does not include all the land in the semi-arid section of the Dakotas and includes much land outside this section in Montana, the estimates provided by Mr. Hopper have been adjusted by the writer on the basis of soil surveys and other data.

[4] The Canadian census provides figures only on the production of wild hay, and the acreage is not included by the census in the total acreage of "field" crops. It has been necessary, therefore, to estimate the acreage on the basis of the yield per acre in the United States of one ton per acre in the sub-humid section and three-fourths ton in the semi-arid section.

TABLE II

SPRING WHEAT REGION AND SUB-HUMID AND SEMI-ARID SECTIONS

(Estimated Land Area, Land Potentially Arable, Crop Area and Pasture Land in Farms, by States, 1924, and Provinces, 1921)

	The Region	*Canadian Portion*	*U. S. Portion*	*Manitoba*	*Saskatchewan*	*Alberta*	*Minnesota*	*North Dakota*	*South Dakota*	*Montana*	*Nebraska*
Land area—total	228,900	115,500	113,400	23,000	57,200	35,300	8,586	42,722	31,192	28,000	2,900
Sub-humid section	100,378	64,800	35,578	23,000	23,800	18,000	8,586	20,632	6,360	....	....
Semi-arid section	128,522	50,700	77,822	....	33,400	17,300	....	22,090	24,832	28,000	2,900
Potentially arable, including present crop area—total	165,000	87,700	77,300	21,000	47,700	19,000	8,100	36,200	19,000	13,000	1,000
Sub-humid section	86,300	52,500	33,800	21,000	20,000	11,500	8,100	19,600	6,100	....	....
Semi-arid section	78,700	35,200	43,500	....	27,700	7,500	....	16,600	12,900	13,000	1,000
Crop acreage—total	69,347*	32,364†	36,983	5,972	17,978	8,414	4,782	19,599	8,388	3,847	367
Sub-humid section	36,604	15,894	20,710	5,972	6,426	3,496	4,782	12,068	3,860	....	....
Semi-arid section	32,743	16,470	16,273	....	11,552	4,918	....	7,531	4,528	3,847	367
Plowable pasture, U.S.—total	Tame and plowable pasture not comparable	....	10,492	....	....	....	540	3,041	3,841	2,465	605
Tame pasture, Canada (in farms)		736†	....	395	206	135	....	.....	.....	.....	.....
Sub-humid section		508	2,514	395	60	53	540	1,342	632	....	....
Semi-arid section		228	7,978	....	146	82	....	1,699	3,209	2,465	605
Non-plowable pasture, U. S.	Tame and plowable pasture not comparable	....	18,313	....	....	....	352	4,944	4,482	7,330	1,205
Natural pasture, Canada (in farms)		27,728†	....	3,275	13,668	10,785	....	....	....	....	....
Sub-humid section		15,744	1,956	3,275	7,819	4,650	352	1,210	394	....	....
Semi-arid section		11,984	16,357	....	5,849	6,135	....	3,734	4,088	7,330	1,205
Total pasture in farms	57,269	28,464†	28,805	3,670	13,874	10,920	592	7,985	8,323	9,795	1,810
Sub-humid section	20,722	16,252	4,470	3,670	7,879	4,703	592	2,552	1,026	....	.....
Semi-arid section	36,547	12,212	24,335	....	5,995	6,217	...	5,433	7,297	9,795	1,810

* It is probable that the areas covered in this tabulation of crop acreage, which was made by counties in the United States and by municipalities in Canada, do not coincide with the areas covered by the estimates of total land area and land potentially arable. The crop tabulation was made on the basis of boundaries drawn by the writer in 1924, whereas the estimates of land area, except for Saskatchewan, and of land potentially arable have been provided, in 1928, by F. A. Wyatt and A. H. Joel, chiefs of the Alberta and Saskatchewan Soil Surveys, respectively, and by R. W. Murchie, Professor of Economics in the Manitoba Agricultural College. The fit is probably close in Saskatchewan, but in Manitoba and Alberta a somewhat larger acreage in crops should be included, probably 10 per cent, in order to be comparable with the figures of land area and land potentially arable. In the United States portion all figures are comparable.

† The tabulation of crop and pasture acreage in Canada was made in 1924 and based on the 1921 census. The 1926 census shows 8.6 per cent increase in crop acreage, but time did not permit a new tabulation, by municipalities of 1926 data. The total pasture acreage in 1926 was about 10 per cent less than in 1921 for the region as a whole.

fall, after a growing season of 100 to 130 days, dominate the agriculture of the region. In addition, corn is a crop of increasing importance in the warmer United States portion, and potatoes are grown throughout the region, but mostly for home use only in the Canadian portion. Hay, nearly three-fourths of which is made by cutting the wild grasses on the poorly drained lands mostly, ranks next to wheat and oats in acreage. Almost no fruits are grown, except bush fruits for home use, because of the severe winters, and practically no vegetables except for home use.

The acreage in wheat is equal to that of all other crops combined in the Canadian portion of the region, but is only 60 per cent that of all other crops in the American section. In the region as a whole its relative importance in acreage, about 43 per cent of the total crop area, is practically the same as that of corn in the Corn Belt, or of cotton in the Cotton Belt; but is not as important, except in the Canadian portion, as hay in the Hay and Dairying Belt. Wheat is relatively more important in the semi-arid than in the sub-humid section of the region, constituting over

FIGURE 175.—A farmstead near Outlook, Montana. This picture shows the final stage in the settlement of the Spring Wheat Region. Note the windbreak on the north and west and the characteristic windmill and the fences indicating livestock on the farm. (Photo by L. A. Reynoldson, U. S. Dept. of Agr.)

40 per cent of the total crop area in this drier section in the United States and about 60 per cent in Canada.

Nearly all the wheat, except that saved for seed, is sold and shipped out of the region, but a little is brought back later as flour. This Spring Wheat Region is now much the greatest surplus-producing wheat region in the world. Most of the bread of Great Britain and much of the macaroni of Italy comes from this region, the macaroni being made from the very hard Durum wheat grown mostly in the Dakotas. The British bread is made from Canadian wheat, since nearly all the wheat, except Durum, grown in the United States portion, is consumed in the United States. It is known as "Northern Hard," and is of high quality.

The acreage in oats in the Spring Wheat Region is nearly half that in wheat; indeed, in the moister subhumid section it is nearly 60 per cent of the wheat acreage in the United States portion and about 75 per cent in the Canadian portion. In the region as a whole oats occupies about 20 per cent of the crop land. Four-fifths is fed in the region, mostly to horses, and a fifth is shipped to eastern Canada, the United States, and England. The proportion shipped out is nearly the same for the United States and Canadian portions of the region. Most of the Canadian shipments go to England. Barley ranks next among the small grains in acreage. In Manitoba it is now as important as oats. About two-thirds of the barley is used locally for feed and a third is shipped east.

The fourth most important crop in the region as a whole is flaxseed. Most of the flax is grown in the United States portion of the region, where production is protected by a high tariff. The acreage was larger than that of barley in this portion of the region in 1924. The Spring Wheat Region produces nearly all the flaxseed grown in North America.

Rye became an important crop in the sub-humid section of the region, especially in the United States portion, during the war years, and even in 1924 constituted about 5 per cent of the total crop area in this United States portion, but less than 2 per cent in the Canadian portion in 1926. Much the same ratio between the Canadian and the United States portions exists for potatoes, which comprise three-fourths of one per cent of the crop area in the United States portion (mostly grown in Red River

Valley) and one-fifth of one per cent in the Canadian portion. Owing to the large yield per acre, the value of the potato crop was about one per cent of the value of all crops in the Canadian portion of the region and about 5 per cent in the American portion.

Corn also is an important crop in the United States portion of the belt, constituting 12 per cent of the acreage of all crops, but is grown in very small quantities in the Canadian portion, owing to the shortness of the season and the cool nights, and almost wholly for forage or silage. The principal forage crop in the Canadian portion is hay, but even of this crop the acreage is less than 40 per cent as much as in the United States portion. In both the Canadian and United States portions wild hay constitutes nearly two-thirds of the total hay acreage, and most of the tame hay consists of the small grains (wheat and oats principally) cut before the grain matures. The total hay acreage constitutes about 7 per cent of the total crop area in the Canadian portion and nearly 20 per cent in the United States portion. It is evident that the Canadian farmers in the region grow a much smaller acreage of forage crops than do the farmers in the United States portion, and this deficiency is not counterbalanced by the greater use of pasturage.

Pastures in Farms

The pastures in farms in the Spring Wheat Region include three-fourths as large acreage as that in all crops. Nearly two-thirds of this pasturage is in the semi-arid section and consists almost wholly of the natural short-grass sod (*grama* mostly); while that in the sub-humid section includes natural tall-grasses, largely blue-stem (*Andropogons*) and needle grass (*Stipas*), also an appreciable acreage of timothy, brome grass, western rye grass, sweet clover, and alfalfa. In the Canadian portion, about 3 per cent of the total pasture acreage in farms consists of the tame grasses in the sub-humid section in 1921, and nearly 2 per cent in the semi-arid section. In the United States pastures are classified by the census on the basis of tillable and non-tillable. The acreage of tillable pastures in the sub-humid section was 55 per cent of all pasture in farms in 1924 (excluding a very small acreage of woodland pasture), but in the semi-arid section tillable pasture constituted only 33 per cent of all farm pasture land.

It will be noted in Table II that there was about the same acreage of total pasture in farms in the United States portion in 1924 as in the Canadian in 1921, and that on each side of the boundary pasturage in farms comprised about a fourth of the total land area. As crop land expanded in the Prairie Provinces over 8 per cent between 1921 and 1926, a reduction in pasture acreage occurred. This reduction, the 1926 census shows, amounted to 10 per cent. It appears probable, therefore, that the acreage of pasture in the Canadian portion of the region, as with hay and forage crops, is smaller than in the United States portion, but not to the same degree.

Woodland in Farms

Although the Spring Wheat Region is a grassland region there is a considerable acreage of woodland in the sub-humid, "grove" or "park" section in Canada. In 1921 the Canadian census reported about

3,100,000 acres of woodland in farms in the sub-humid section, which is over 6 per cent of the land area, and only 167,000 acres in the semi-arid section, which is one-third of one per cent of its land area. In the United States portion of the region about 1,000,000 acres were reported by the Census of 1924 in the sub-humid section and 600,000 acres in the semi-arid section, which results in percentages of three and of less than one respectively. The "groves" in the sub-humid section of Canada are composed almost wholly of aspen (*Populus tremuloides*), practically all of small size and readily cleared, while the woodland in the semi-arid section, and throughout most of the United States portion of the region, consists mostly of cottonwood (*Populus occidentalis*), willow and a little elm and ash along the streams. There are also a few pines along north-facing rocky slopes in Montana and southern Saskatchewan. Very little of the woodland in the region is valuable for other uses than firewood, but some of the aspen in the Canadian portion is sold for pulp wood. The value of forest products of farms in the sub-humid "grove" section in Canada amounted to over $3,000,000 in 1920, but in the semi-arid section to only $225,000. The value of firewood cut in the United States portion of the region was about $150,000 in 1924.

FIGURE 176.—The old and the new in Alberta. The old house, built by a Russian settler soon after arrival was made of aspen or willow logs, plastered over with mud and the roof thatched with straw. Usually the window frame and sill are painted blue. The building is now used as a tool house. The new house is of typical frame construction. Note the Ford automobile. (Photo from Nat. Res. Int. Service of Canada.)

Livestock

The Spring Wheat Region was originally the summer range of vast herds of buffalo. Later, it was the grazing ground for millions of cattle and sheep. The cattlemen held dominion almost everywhere until the early eighties, and still hold dominion today along the arid margin of the

region, except where the range is very dry and better suited to sheep. Despite the plowing up of so much of the land for crops, there has been no diminution in number of cattle, the crop feed produced balancing the reduction in pasturage. But, the large cattle ranches are mostly gone and in their place are the family farms of the homesteaders. These farm families have lots of leisure in the winter time (see Fig. 161), which the feeding and milking of cows helps to reduce with profit. Moreover, these families need milk for home use at all times of the year; and the butter made has a high value per unit of weight and can easily stand the cost of transportation to distant markets. So the drift has been strongly from beef cattle toward dairying. Already two-thirds of the cows in the United States portion of the region are milked, though less than half are classified as dairy cows; while in the Canadian portion over 80 per cent of the cows are milked.

Dairying has developed most rapidly, as might be expected, in the moister sub-humid section, where more and better hay is raised and the pastures are more productive. Although this sub-humid section contains only 50 per cent of the total cattle in the region it possesses over 60 per cent of the cows milked. There were nearly a million cows milked in the Canadian portion of the region in 1925 and another million in the American portion in 1924. The production of milk increased between 1919 and 1924 nearly 40 per cent in South Dakota, over 40 per cent in North Dakota, about 45 per cent in Montana, and nearly 50 per cent between 1920 and 1925 in each of the Prairie Provinces. During the past year (1926–1927) a decline in dairying has occurred in the Canadian portion of the region, but the winter employment provided by dairying, the regularity and certainty of income, the contribution which dairying makes to the maintenance of soil fertility, both by promoting rotation of crops and by providing manure—all point to resumption of the trend toward dairying in the Canadian portion of the region, especially in the sub-humid section.

In North Dakota nearly 90 per cent of the farmers reported cows milked in 1924, in South Dakota 85 per cent so reported, and in each of the Prairie Provinces about 80 per cent of the farmers milked cows in 1925. The farms having cows in each of these states and provinces averaged from six to seven cows milked per farm, and the value of milk and dairy products was from $200 to $300 per farm producing milk. Although at present the value of dairy products produced in the sub-humid section is not over one-fourth that of the wheat in the Canadian portion and in the United States portion is only one-fifth, there are many localities in which dairying has become the leading industry, and it seems not unlikely that within half a century this will be true of the sub-humid section as a whole. This sub-humid section of the Spring Wheat Region is the only area of considerable size in North America that appears likely to so change its agriculture as to require future inclusion in another agricultural region, or, perhaps, recognition as a distinct region. Wheat will undoubtedly remain the major crop, and the area will be quite distinct in this respect from the Hay and Dairying Belt to the east.

Beef production remains an important industry in the region, especially

FIGURE 177.—Another Russian's house in Alberta. The fine home of Harry Winachuk, a Russian, in the Vegreville district, east of Edmonton, Alberta. Mr. Winachuk homesteaded a quarter section here fifteen years ago, with the only $10 he had left. He recently moved from the old shack shown in the picture to the new $5,000 home to the left, which is equipped with electric light, water, and telephone. He now farms five quarter sections, has everything paid for, and has nearly $1,000 in the bank, besides a sturdy family of seven children. (Photo from Publicity Branch, Dept. of Immigration and Colonization of Canada.)

in the semi-arid section. There were nearly 2,000,000 cattle in the United States portion of this semi-arid section on January 1, 1925, mostly of beef breeds, but only 1,000,000 in the Canadian portion. In the sub-humid section there were about the same number of cattle in the Canadian and in the United States portion—1,500,000 in each, mostly of dairy breeds. The value of the cattle sold and slaughtered in the Canadian half of the Spring Wheat Region was greater than that of milk produced in 1925, and it is probable that this is true also of the United States half. Adding the value of the cattle sold and slaughtered to that of milk and dairy products gives a total value of nearly $100,000,000 in the Canadian portion in 1925, and probably of $125,000,000 in the United States portion. In the Spring Wheat Region as a whole the products of cattle have a value almost one-third that of the wheat crop.

Horses are of much greater value, however, than cattle in the region, and undoubtedly of greater importance, for they provide power to plow the land. There are over 2,000,000 in the Canadian portion of the region, and nearly 1,600,000 in the United States portion. Fully 90 per cent of these are work animals. The area of crops (including crop failure) per work animal (including a few mules) in the Canadian section in 1926 was 20 acres, and in the United States portion in 1924 over 25 acres. This greater efficiency on the United States side of the line is not owing to greater use of tractors, for there were only 36,000 tractors in the United States portion of the region and nearly 50,000 in the Canadian Prairies. Nor is the difference attributable to crops grown, for the acreage of corn, potatoes, and other crops requiring intertillage, and therefore much horse labor, is many fold greater in the United States portion. Probably the principal reason is the much greater area in summer fallow on the Canadian side. Partly as a consequence of this practice the

yield of wheat in the Canadian portion of the region during the eight years, 1920–1927, averaged over 16 bushels, and in the United States portion only a little over 11 bushels. Apparently the larger number of horses kept by the Canadians are worth while.

There are very few sheep left in the Spring Wheat Region—1,500,000 in the United States portion and 800,000 in the Canadian. These sheep are found on only 25,000 farms, only one farm in fifteen. Many of these "farms" are not farms, but sheep "outfits" consisting of a camp tender, usually the owner, and one or more herders, who drives the flocks before him along the hot bottoms and stony slopes of the desert-like valleys that ramify into the plains. Descending from the higher "bench" lands, with their waving fields of grain, twelve-horse teams, and tractors, into one of these desert valleys with its sage brush, coyotes, and rattlesnakes, and finding there a Basque shepherd with his flock, reminds one of Palestine and the Shepherd's Psalm: "Yea, though I walk through the valley of the shadow of death, I will fear no evil; for thou art with me; Thy rod and thy staff they comfort me."

Hogs and chickens are today much more important than sheep in the region. There are about 4,000,000 swine in the region, 2,400,000 in the United States portion and 1,600,000 in the Canadian; and the more than 3,000,000 hogs sold or slaughtered on farms yearly have a value of about $30,000,000, which is over a third that of milk produced. The 27,000,000 chickens, 12,000,000 in the United States portion and 15,000,000 or more in the Canadian, produce meat and eggs worth about as much as hog products. Nearly 5,000,000 chickens, having a value of $2,000,000, were sold or eaten on farms (mostly eaten) in the Prairie Provinces in 1925; and the value of eggs produced exceeded $11,000,000. The poultry products were probably of equal value in the United States portion of the region. In addition over 700,000 turkeys were sold or slaughtered in the Canadian portion of the region during 1925, and it is probable that as many more were raised in the United States portion. The weed seeds and screenings from the wheat have been found to make excellent turkey as well as chicken feed, and with the recent introduction of an attachment to the threshing machine that separates the weed seeds from the wheat on the farm, the production of poultry, especially turkeys, has increased rapidly. The dry climate also favors raising the young turkeys to maturity.

Taken altogether, the annual value of the livestock products of the Spring Wheat Region, other than power, will average about one-half that of the wheat crop.

SYSTEMS OF FARMING

There are four major systems of farming in the Spring Wheat Region: (1) wheat farming, (2) general farming, (3) dairying, and (4) cattle ranching (Fig. 158). Dairying and stock ranching have, perhaps, already been sufficiently described, but wheat farming and general farming deserve further attention. General farming means in this region a little more oats and hay and livestock than in wheat farming, and may well be included with it under a description of small grain farming.

As already indicated, small grain farming is the dominant system of

farming. Over 85 per cent of the farms in the Canadian portion of the region grew wheat in 1926, nearly 70 per cent of the farms in Manitoba, over 90 per cent in Saskatchewan, and 86 per cent in Alberta; while in North Dakota in 1924 the proportion was 88 per cent and in the parts of Montana and South Dakota included in the region was about three-fourths. The proportion of the farms that grow oats is almost as high as for wheat in both the Canadian and United States portions of the region.

Saskatchewan to 10 acres in Alberta. In Alberta there are also about 3 acres of cultivated grasses or alfalfa per farm. About two-thirds of the farms grow potatoes, but mostly for home use only, as the average area per farm is half an acre. Only a few farms (12 per cent) in the Canadian portion of the region grow flax, mostly those that have raw land, or land on which flax has not been grown for seven years, and is, therefore, free from the wilt disease.

Thus, it will be seen, that in the

FIGURE 178.—A Hungarian settler's farmstead in Manitoba. Note the windbreak and the windmill, and, rather unusual, the hogs in the foreground gleaning in the wheat field. (Photo from Nat. Res. Int. Service of Canada.)

These small grain farms average about 150 acres of crops per farm in Manitoba of which nearly 60 acres are in wheat, 40 in oats, and 40 in barley. In Saskatchewan the grain farms are larger, averaging perhaps 180 acres of crops per farm of which 120 acres are in wheat and 40 acres in oats. In addition about a third of the farms grow 20 to 30 acres of barley. In Alberta the average area in wheat per farm is 93 acres, but only 30 acres in oats and 16 in barley, which latter crop is grown on only a third of the farms. In Alberta the acreage in hay and forage crops is much larger than in the other provinces. About half the farms in each province grow forage crops but the area per farm is small, from 5 acres in

Canadian Prairies a fourth to a third of the crop land is devoted to crop feed, mostly oats, for the livestock, principally horses and cattle, and two-thirds to three-fourths to cash crops, mostly wheat, flax, and rye, and also a part of the barley. This dependence on cash crops is characteristic also of the Hard Winter Wheat Region to the south and the Cotton Belt. Such systems of farming sooner or later involve serious problems in maintaining soil fertility. There are apparently only two solutions, a shift toward livestock, or else the use of mineral fertilizers combined with green manure crops. In the sub-humid portion of the Spring Wheat Region, the shift toward livestock, especially dairying,

has made rapid progress, as already noted; but in the semi-arid section, less adapted to dairying, the solution is not yet clear. It may prove that these semi-arid grassland soils are not depleted of their fertility at as rapid rate as is common in soils formerly forested. Indeed, the production of wheat on the plains of Roumania and Sicily for 2,000 years or more with almost no manure or artificial fertilizers suggests that in semi-arid climates there is some means by which the essential mineral salts sufficient for a low to fair acre-yield of wheat are replenished naturally.

In the United States portion of the Spring Wheat Region, the grain farms are similar to those in the Prairie Provinces, but more hay and corn are grown. In North Dakota, for instance, as in Saskatchewan, about 90 per cent of the farmers grow wheat, and the average acreage per farm reporting is about the same (120 acres), while there is also the same average area in oats (40 acres per farm). More than half the farmers in North Dakota grow barley (as compared with a third in Saskatchewan), and they grow a larger average acreage (30 acres per farm). But most significant are the 30 acres of corn, more or less, grown on two-thirds of the farms of North Dakota, as compared with almost none in Saskatchewan; and the 30 acres of hay, on the average, one-third of which is tame hay, cut on four-fifths of the farms in North Dakota, as compared with the 7 acres of hay per farm, practically all in wild hay, in Saskatchewan. More corn and more hay mean more livestock, more manure, more protection against dry years, and a more even seasonable distribution of labor. At best, the seasonable distribution of labor on small grain farms in the region is bad (see Fig. 161); and the more time that the farmer can put into farming, the more income he will receive in the long run. North Dakota, of course, has a climatic advantage in the production of corn, but the time will come, doubtless, when the farmers of Saskatchewan will be cutting as much, if not more hay per farm, and feeding as many cattle, as the farmers of North Dakota.

Owing to its distance from centers of consumption, a large part of the principal surplus commodities of the Spring Wheat Region, wheat and milk, is concentrated for shipment into flour and butter. Minneapolis, which is located only a few miles east of the region, has become the greatest wheat-milling center in the world, and the number of creameries in the region is rapidly increasing. The production of butter leaves skim milk as a by-product, and in order to utilize the skim milk to advantage, it may be expected, as dairying increases, that the production of hogs will increase; but not to such an extent as in the Corn Belt, because there is no grain available for feed so cheap as corn in the Corn Belt. Barley takes the place of corn, more or less, and the hogs, owing to these conditions, are commonly of the bacon type.

SIZE OF FARMS

The Spring Wheat Region is an area of large farms, particularly the United States portion. Prior to the World War the acreage of crops per farm was rapidly increasing in the Dakotas, Saskatchewan, and Alberta, but since the War, if crop failure be included in the 1919 acreage, there has been no increase in average acreage per farm in the

United States portion of the region (see Table I). But in the Canadian portion the acreage per farm is growing larger since the World War, even in Manitoba, where it had been stationary for twenty years.[5] However, in the Canadian portion of the sub-humid section, the average area of farm land per farm is still 68 acres less than in the United States portion, and in the semi-arid section 149 acres less (see Table III). This difference is owing probably in part to the lesser capital of the settlers and less commercialized agriculture in the Canadian portion of the sub-humid section and to the larger proportions of rough land in the United States part of the semi-arid section.

TABLE III

SPRING WHEAT REGION AND SUB-HUMID AND SEMI-ARID SECTIONS

(Acres of Farm Land and Crop Land, including wild hay, per farm. United States portion 1924, Canadian portion 1921)

	Farm Land, Acres Per Farm		*Crop Land, Acres Per Farm*	
Regions, Provinces and States	Sub-Humid Section	Semi-Arid Section	Sub-Humid Section	Semi-Arid Section
The region	346	511	170	200
U. S. portion	393	590	277	216
Canadian portion	325	440	128	188
Manitoba	325	...	150	...
Saskatchewan	347	407	109	193
Alberta	293	511	123	176
South Dakota	344	612	250	220
North Dakota	410	500	289	243
Montana	...	719	...	176

The difference in size between the Canadian and American farms in the region is even greater when measured in acreage of crops for the sub-humid section, but is less marked in the semi-arid section, where settlement in the Canadian and United States portions was nearly simultaneous and people and system of farming are very similar. In the longer settled, sub-humid section the farms on the United States side of the boundary average more than twice as large acreage in crops as on the Canadian side. In the semi-arid section the farms average only 15 per cent larger crop acreage in the United States than in the Canadian portion.

At the present rate of increase in size of farms in the Canadian portion of the sub-humid section it will be many decades before the farms attain as large size as in the United States portion, and great resistance may be expected because of the weaker commercial motive among the large number of foreign-born farmers in Canada, and the lesser opportunities for alternative employment in the cities. Moreover, if dairying continues to develop in this sub-humid section, the farms will tend to become smaller rather than larger.

It will be noted in Table III that in Canada there is a larger acreage of crops per farm in the semi-arid section than in the sub-humid, whereas in the United States this relationship is reversed. Both total acreage and crop acreage per farm should be larger in the semi-arid than in the sub-humid section, if an equal income is to be obtained, because the land is drier, the acre-yields of the crops are lower, and the vicissitudes of the season compel a larger dependence on pasturage. It would seem that in

[5] In Manitoba total acreage per farm has decreased, but crop acreage per farm, a better criterion of size, has increased. In South Dakota both total acreage and crop acreage have decreased, probably owing in part to the advance of corn, which requires more labor per acre than wheat, and brings with it associated livestock enterprises.

the United States portion of the semi-arid section the crop acreage per farm is too small, owing doubtless to the same reasons as in Canada, *i.e.*, recent settlement and lack of capital. The introduction of the tractor and combine may be expected to increase rapidly the crop acreage per farm throughout the semi-arid section.

TENURE OF FARMS

The Spring Wheat Region is a newly settled country and the percentage of farm tenancy may be expected to be low. Not as large proportion of farmers are old enough or have acquired wealth enough to move to town and rent their farms as in long settled regions; and where land is cheap the young men prefer to buy farms as soon as possible, and profit by the rise in land values. But, the United States portion of the region is ageing rapidly. Since the World War, owing to the agricultural surplus and relative decline in prices of farm products, land values have ceased to rise, indeed, have fallen greatly; and many young men who bought land under a mortgage, have had the mortgage foreclosed and been forced to become tenants. The proportion of farmers who were tenants increased in South Dakota, the longest settled state, from 34.9 per cent in 1920 to 41.5 per cent in 1925; in North Dakota from 25.6 per cent to 34.4 per cent, and in Montana, recently settled, from 11.3 per cent to 21.9 per cent. In South Dakota the proportion is higher than in the United States as a whole. In the Canadian Provinces the proportion of farmers who are tenants is much lower, but the same trend exists. In Manitoba, and in Saskatchewan, also, tenancy increased from 11 per cent in 1921 to 17 per cent in 1925, and in Alberta from nearly 10 per cent to nearly 14 per cent. On the other hand, in the eastern United States and Canada the percentage of farmers who are tenants is declining.

A notable difference exists also between the sub-humid and semi-arid sections in the proportion of farmers who are tenants. In the United States the proportion who were tenants was 38.6 per cent in 1925 in the sub-humid section and 27.6 per cent in the semi-arid. The semi-arid section, being more recently settled and having a large number of cattle ranches along its arid margin, which are ill adapted to tenant operation, has the smaller percentage of tenancy. But in Canada the reverse condition is revealed by the census—in Alberta, as well as in Saskatchewan, the proportion of the farmers who are tenants was 9 per cent in the sub-humid section in 1921 and 13 per cent in the semi-arid section.

This small percentage of tenancy in the sub-humid, "grove" belt of Northwest Canada, as well as the small size of the farms previously noted, indicates a less commercialized and more self-sufficing agriculture than in the semi-arid "plains" section. It suggests also a larger proportion of European immigrants in the sub-humid belt than in the semi-arid section, and a larger proportion of native Canadians and Americans in the semi-arid section than in the sub-humid. This surmise was checked for Saskatchewan by tabulating the birthplace of farm operators by census divisions, which can be segregated into sub-humid and semi-arid sections only approximately. This tabulation shows that in the semi-arid "plains" section of Saskatchewan over 37 per cent of the farmers were born in Canada, nearly

18 per cent in the United States, or about 55 in America, and less than 25 per cent in Continental Europe; whereas in the sub-humid "grove" belt only 27 per cent of the farmers were born in Canada, less than 12 per cent in the United States, or less than 39 per cent in America, and over 41 per cent in Continental Europe. The influence of race upon agriculture, at least temporarily, is indicated by these figures, and it appears worth while to consider, briefly, the population of the region.

FIGURE 179.—A Norwegian home in Alberta. The home of O. B. Nordstrum, north of Viking, Alberta. It was natural that Mr. Nordstrum, a Norwegian, should settle near the town with the name of Viking. He is of the type of settler that Alberta likes to have. He came from Norway 21 years ago, and has made it stick to such a success that he has built for himself this fine farm home. (Photo from Publicity Branch, Dept. of Immigration and Colonization of Canada.)

THE PEOPLE

The Spring Wheat Region was the last part of North America to be settled by farmers; it still has a frontier along the northern and southern borders, and extension of the crop area continues not only along these margins but also within the region itself, and often within each farm. In nearly all other parts of the United States and Canada, crop acreage is stationary or contracting.

The frontier in North America not only moved from east to west, but also, after the settlement of California and Oregon, it moved, during the latter half of the nineteenth century, from west to east, across the deserts and the mountains. Although this eastward moving frontier was based on mining, agriculture soon developed near the mining camps. During the same years the cattlemen advanced in the Great Plains Region from south to north, lured on by virgin pastures. These three streams met in the Spring Wheat Region.

Races

More recently a fourth stream of people, as important as any of the other three, has contributed to the settlement of the country—a stream of immigrants direct from Europe. The Spring Wheat Region not only possesses still many of the characteristics of a pioneer area, but also, like many American cities, it is a melting pot of peoples of diverse races and religions. In this respect no other rural part of North America can compare with it.

Of the farm operators in the three Prairie Provinces in 1926, about 83,000 were born in Canada, 39,000 in the United States, 76,000 in continental Europe, 44,000 in the British Isles, 800 in other British possessions, and 300 in Asia. Of those born in

Canada, over half were born in Ontario, and only a ninth in Quebec. More significant are the countries of Europe that supplied the immigrants: Galicia 9,400, Poland 4,000, Roumania 4,800, Russia 13,345, Ukraine 6,904—total Slavic (presumably) nearly 40,000; Iceland, 1,000, Norway 8,500, Sweden 6,000, Denmark 1,700—total Scandinavian over 17,000; Germany 4,300, Austria 8,000—total German (presumably) 12,300; Hungary 2,000, Finland 800—total European-Mongolian (presumably) 2,800. It will be noted that there are as many immigrant farmers from Slavic Europe as from the United States, nearly two-thirds as many Scandivanians and Germans as immigrants from the British Isles. But, the farmers of Anglo-Saxon ancestry still remain in the majority; indeed, they constitute nearly two-thirds of the total. Therein lies safety for the splendid political and educational systems which the people of the Prairie Provinces have developed.

However, an ominous shifting of the population is in progress. Between January 1, 1921 and June 1, 1926, over 50,000 immigrants arrived in the Prairie Provinces from continental Europe, and nearly 85 per cent of these recent immigrants residing in the Prairie Provinces (that is 85 per cent of 51,829) were found by the census of 1926 in rural territory. Recalling that the numbers of farms in the Prairie Provinces decreased over 7,000 during these years, it appears that the original pioneer stock, largely Canadian, British, American, and Scandivanian, is rapidly moving to town and leaving the land to the European immigrants. The significance of this shift resides in the fact that for every thousand women 20 to 44 years of age living in the rural portions of the Prairie Provinces, there are 860 children under 5 years of age, whereas for the women in urban territory, there are 515. In Manitoba the ratio is 850 to 456. In more ways than one, the farm feeds the nation.

In the United States portion of the region the diversity of race is not nearly so great as in the Canadian, most of the immigrants from Eastern Europe having been sieved out by the Eastern cities before they could reach the center of the continent. However, about two-thirds of the people are of foreign birth or parentage, mostly of Teutonic stock. Scandinavians are almost as numerous as the native Americans, and there are about half as many Germans, located mostly in the southeastern part. These Scandinavians and Germans are thrifty, industious, cleanly, and capable peoples, progressive in politics and strongly supporting educational institutions. These, and the English Canadians, who constitute about 5 per cent of the population, cause no anxiety to the advocates of Americanization: in fact, it would never occur to anyone to think of them as other than as excellent American citizens. There are, however, about 100,000 people of Russian origin and a few Hungarians in the Spring Wheat States, living mostly in the semi-arid section of the Dakotas, who have tended to live to themselves, especially the original immigrants. But, the public school and the influence of the surrounding civilization quickly Americanizes the children, many of whom grow up to be public-spirited citizens.

Education

Unlike nearly all other regions where the proportion of foreign stock is high, there is less illiteracy among the rural population of the United States portion of the Spring Wheat Region than in any other part of the United States, except the Corn Belt. In the Dakotas and Montana, of the rural population over 10 years of age, only 2 per cent are illiterate. The foreign-born, however, average over 5 per cent illiterate, whereas the people of native parentage average less than 0.4 of one per cent. These are the lowest percentages for rural population to be found in the United States, except for the population of native parentage in Idaho, and for foreign-born in Nebraska. As soon as the foreign-born are dead, illiteracy will be practically non-existent in the United States portion of the region, for the population of foreign parentage has almost as low a rate of illiteracy as those of native parentage.

Illiteracy in the Canadian portion of the Spring Wheat Region exceeds 5 per cent, which is more than double the rate in the United States portion. It is lowest in Alberta and highest in Manitoba. Even among the Canadian-born it averages nearly 2 per cent, which is five times as great as among the native-born in the Dakotas and Montana. Moreover, the residents of the Prairie Provinces who were born in the United States have an illiteracy rate nearly double that of the native-born in the Dakotas and Montana;[6] while the other foreign-born in the Prairie Provinces (excluding the British whose rate is very low) have an illiteracy rate over twice that of the foreign-born in the Dakotas and Montana. Illiteracy in Manitoba is notably high for all classes of the population, except for the British born. Of the immigrants from continental Europe, 25 per cent are illiterate in rural Manitoba, as compared with 17 per cent in Saskatchewan and 15 per cent in Alberta. Such a proportion of illiteracy is found in the United States only among the foreign-born in the Northeastern States, and among the negroes and Mexicans of the South.

In school attendance, however, there is little difference between the Canadian and United States portions of the regions. In South Dakota 93.3 per cent of the rural children 7 to 13 years old attended school in 1920, in North Dakota 91.8 per cent, in Montana 92.1 per cent; while in Manitoba in 1925 the proportion was 89.3 per cent, in Saskatchewan 91.6 per cent, and in Alberta 90.5 per cent. It appears certain, therefore, that in a few decades illiteracy in the Prairie Provinces will be reduced to a percentage closely approaching that in the United States portion of the region.

Religion

Religious denominations in the Spring Wheat Region are more numerous than the races. The Evangelical and Lutheran churches,

[6] This suggests a difference in definition of illiteracy in the Canadian Census from that in the United States Census. However, such difference, if it exists, can account apparently only in part for the higher illiteracy in the Canadian portion of the region. A pioneer region attracts the poor in education as well as in purse, but also rich in ambition and hope.

including fifteen denominational organizations that bear both names, have the greatest number of communicants in the United States portion of the region, about 250,000 in all in 1926. The Roman Catholics are almost as numerous. Then follows, at a long distance, the Methodist Church (60,000 members), Presbyterian (35,000), Congregational (30,000), Protestant Episcopal (25,000), and the Baptist (20,000). The membership of all denominations of English and American origin probably does not exceed 250,000. These estimates include city as well country churches. As the total population of the United States portion of the Spring Wheat Region is about 1,400,000, it would appear that more than half of the population are church members, and that the known membership is about equally divided between the Teutonic Protestants, American Protestants, and Catholics. In addition, there is an unknown number of communicants of the various Greek Catholic churches.

In the Canadian portion of the region there are probably many more denominations represented than in the United States portion. Unfortunately the writer does not have at hand a religious census of Canada. But, he recalls the picturesque and beautiful Russian Orthodox churches, with their pear-shaped spires, in Ukrainian and Russian settlements, the quaint and charming architecture of some of the Norwegian and Swedish churches, the sharp spires of several German edifices, as well as the characteristic charm and modesty of the Protestant Episcopal churches, the diversified architecture of the Presbyterian, Congregational, and Methodist churches, and, in a few cities, the readily recognized Romanesque style of the Christian Science Church.

Democracy

In the Spring Wheat Region one finds democracy at its best, few rich, few very poor, after the first few years of struggle and sifting on the frontier are over; a dominantly rural, optimistic, progressive, tolerant, and kindly people, gathered from all parts of Europe and North America, just emerging from the pioneer stage of economic and social development, striving to grow more wheat, or produce more milk, and get a better price, in order that better homes may be built, better schools provided, and those facilities for comfort and pleasure secured which few hope for in Europe, but all expect in North America.

About a fourth of the farm homes in Manitoba and Alberta had telephones in 1926, and a third had automobiles. In Saskatchewan the proportion was higher—almost 43 per cent of the farmers had telephones and the same percentage had automobiles. In the United States portion of the region no figures are available since 1920, when 57 per cent of the farmers in North Dakota had automobiles and 47 per cent had telephones. In South Dakota the proportions were still higher, 69 and 59 per cent respectively. However, few farms in the region have water piped into the house—from 1 to 2 per cent in the Canadian Provinces, and from 6 per cent in Montana and North Dakota to 12 per cent in South Dakota. About 2 per cent of the farm houses have gas or electric lights in the Prairie Provinces, 4 per cent in Montana, 6 per cent in North Da-

kota, and 9 per cent in South Dakota. About the same proportion of farms in these three states had radio outfits in 1925. Clearly the proportion of the farm families in the Spring Wheat Region who enjoy these comforts of modern life is very much smaller than among city dwellers in both the United States and Canada. But, perhaps the proportion who are accumulating a competence, and can look forward to old age with equanimity, is greater among these farmers of the Northwest than among the dwellers of our cities.

(NOTE.—Dr. A. H. Joel, Professor of Soils in the University of Saskatchewan, writes to Dr. Baker as follows: "I should like to make some corrections to the article which you have sent me for approval and which is to appear in ECONOMIC GEOGRAPHY.

"You mention that the seasons are too brief for corn to mature; that is not always true, for in some especially favorable seasons we are able to mature the early varieties of corn and to produce some very good ears.

"You also mention that the depth of the lime layer is four or five feet along the forest margin, two to three feet deep half-way across the sub-humid tall-grass section, and eighteen inches deep where the tall grass and short grass overlap. In Saskatchewan, at least, all these depths are too great for all but the very light soil types. I know personally that the depth of the lime layer in the Alberta timber soils and real black soils is greater than in similar types in Saskatchewan where the depths average more nearly three feet, eighteen inches, and twelve inches respectively for the three depths mentioned above.

"You also mention that the northern boundary of the spring wheat belt is at the beginning of the forest, either of aspen or evergreen. There is a definite encroachment beyond this boundary well into the timber area, especially into the northeastern part of settled Saskatchewan; and with the recent introduction of very early varieties the belt promises to extend even farther north.")

BOOK REVIEWS

DEPARTMENT OF COMMERCE

Bureau of Foreign and Domestic Commerce

Commerce Yearbook, 1928

The *1928 Commerce Yearbook*, like the previous issue, is in two volumes. Volume I is already published and Volume II will appear during October. The first volume is a survey of business conditions in the United States including manufacturing, mining, construction, agriculture, transportation, and domestic trade. It contains some valuable surveys relating to these problems as well as much statistical, map, and graphic material. Inasmuch as the domestic market consumes a large portion of American production, the significance of this analysis may be realized. The foreign trade of the United States is reviewed in detail. In 1927 the export trade of the United States was larger than in any other recent year, while the value of imports continued at about the same high level as in 1926. A sharp decline in average level of world prices during 1927 caused a decrease of seven per cent in the average prices received for American commodities shipped abroad and almost as large a decrease in the average prices paid for imports. The export trade in 1927 showed increase in shipments of crude foodstuffs and semi-manufactured articles and decrease in exports of crude materials and manufactured foodstuffs. Exports of finished manufactures continued to expand both in value and quantity, chiefly as a result of a substantial increased foreign demand for American automobiles and machinery. The price of Volume I is $1.25.

Volume II of the yearbook deals with foreign countries. It is the second issue of the separate volume covering foreign data. The reviews and statistics presented indicate in general a continuance in the improvement in the world economic situation which has taken place during recent years. Production of commodities in the world as a whole and in most individual countries now exceeds the pre-war volume and international trade is appreciably greater. The only serious unfavorable feature in the world situation in 1927 was the continuance of political and economic disturbances in China.

The volume consists essentially of two parts. The first includes a series of sections each dealing with a single foreign country. Seventy-three countries have been covered. Each of these sections comprises a review of recent economic conditions and events, together with statistical tables and text covering the latest available economic information with comparisons for preceding years. Fifteen country maps illustrate this portion of the volume. The second part of the volume consists of comparative statistical tables in which data as to major subjects are presented for the various countries side by side. Statistical world maps present both foreign trade of the United States and international trade. Six Goode physical-political maps supply reference material for the continents. The dot population map of the world and an index map of the world are also included.

The collection of the basic data for tables and text of this book has involved the coöperation of all the foreign offices of the Bureau of Foreign and Domestic Commerce, and of many officers of the Consular Service with the Washington Office of the Bureau. In a number of instances foreign governments have been particularly helpful in furnishing statistical information in advance of ordinary publication.

The Baltic States (Esthonia, Latvia, and Lithuania): A Short Review of Resources, Industry, Finance, and Trade. Trade Information Bulletin No. 569. Price, 10 cents.

The three Baltic Republics—Esthonia, Latvia, and Lithuania—formed as a result of the war from former Provinces of the Russian Empire, offer a field of decided interest and of very considerable potential value to American trade. Greatly weakened by war, revolution, and the disruption of the Russian market, these States on their establishment were confronted with seemingly overwhelming difficulties. The success with which the problem of reconstruction along financial, political, and economic lines has been met in each of these States is a remarkable achievement. The share of the United States in their foreign trade is considerable and is growing in importance. A notable feature of it is the increasing importance of manufactures in the imports of the United States. The present study reviews the basic economic conditions of the three Baltic States in such a way as to give a clear appreciation of the present status and the future possibilities, particularly in their bearing on international trade.

The Balance of International Payments of the United States in 1927. Trade Information Bulletin No. 552. Price, 10 cents.

This is the sixth consecutive annual study of the balance of international payments of the United States to be published by the Department of Commerce. It contains detailed calculation of tourist expenditures, the second largest "invisible" item in our international balance. It contains more new information on immigrant remittances than has been published since the pre-war investigations. There are new data on foreign investments in the United States. Four

items, heretofore estimated, appear for the first time as statistically compiled items: bunkerage, earnings of American vessels, sales and purchase of vessels, and cablegram and radiogram charges. Four items are entered for the first time: Changes in gold earmarked for foreign account, consular-invoice fees, expenditures for diplomatic representation, and patent and trademark transactions. Our international turnover last year was approximately $18,200,000,000, so that our per capita foreign dealings amounted to about $152. Last year we sold to customers abroad about $4,500,000,000 worth of commodities. The aggregate profit thereon and the productive employment created by those sales are among the very bases of our national welfare.

The International Cartel Movement. Trade Information Bulletin No. 556. Price, 10 cents.

Many American business men and students of international economic movements have wished information regarding the international cartel movement. The present report aims to give a clear idea of the scope and significance of the movement and its background as shown by the tendency toward the formation of cartels in Germany and a few of the other European countries of industrial importance. No attempt has been made to deal with the legal aspect of the cartel, except the brief reference to the discussion of the possibility of international control at the World Economic Conference at Geneva, nor with the cartels in trade, shipping, or other nonindustrial fields.

Luxemburg, A Brief Economic Survey. Trade Information Bulletin No. 559. Price, 10 cents.

Since the coming into effect in 1922 of the agreement for an economic union with Belgium, Luxemburg's foreign-trade statistics have been merged with those of Belgium; hence no complete record of the commerce between the Grand Duchy and the United States can be given. Nevertheless, considering its small area and population (for it is one of the smallest of the independent nations of Europe), Luxemburg has a relatively large trade with this country in certain merchandise, including primarily imports of automobiles and exports of steel products; considerable shipments of leather and gloves also are made to the United States.

The Trade in Iodine. Trade Information Bulletin No. 561. Price, 10 cents.

Iodine, although not a large item in world trade, is of great importance in medicine and for other purposes. Therefore, the control of commercial supplies of this commodity by a foreign monopoly is a matter of concern, not only to the American pharmaceutical industry, but to the world at large. Imports of iodine into the United States during 1927 amounted to 926,000 pounds, valued at $2,900,600. All of this was of Chilean origin.

Latin American Budgets. Part IV, Central America and Panama. Trade Information Bulletin No. 564. Price, 10 cents.

The five years ending in 1927 represent a period of great economic prosperity for most of the countries of Central America, especially those which are large producers of coffee—Guatemala, Salvador, Costa Rica, and Nicaragua. In recent years coffee prices have been relatively high and the crops generally above the average in both quantity and quality. A feature of the recent financial history of the Republics of Central America and Panama has been the marked interest shown in the development of natural resources and in the construction of highways and other public works. Increased revenues have provided for a considerable portion of these expenditures on public works, although a considerable number of countries have resorted to foreign loans in fairly large amounts. In fact, if expenditures for the construction of public works were segregated from ordinary administrative expenditures, the deficits shown for certain countries, such as Panama, would be considerably reduced, and this raises the question as to what capital expenditures may be properly included in the ordinary budget.

Employment for Americans in Latin America. (For Distribution.)

This little pamphlet presents an interesting survey of opportunities for employment in Latin American countries based upon actual conditions in those countries.

Commercial Readjustment in Brazil, 1927. Trade Information Bulletin No. 560. Price, 10 cents.

Commercial relations between the United States and Brazil have always been close. The United States is by far the best customer Brazil has, and Brazil, on the other hand, is using more and more of our products. The United States furnishes the greater part of Brazil's imports of hides and skins, wheat flour, barbed wire, agricultural and industrial implements and machinery, motion pictures, automobiles, and petroleum products.

Boot and Shoe Industry and Trade of New Zealand. Trade Information Bulletin No. 554. Price, 10 cents.

Annual imports into New Zealand of about $175 for each person in the Dominion make it one of the highest per capita importing areas in the world. Imports from the United States have grown steadily during the last decade and amounted to $32,500,000 in 1927. It can be safely said that there is a market in New Zealand for practically every product manufactured in the United States. The United States ranks third among

countries supplying boots and shoes to New Zealand, being preceded by Great Britain and Canada.

Cotton Fabrics and Their Uses. (For Distribution.)

It is characteristic of modern business that it relies more and more upon technical and economic facts. While a considerable fund of statistical and economic information is available to guide the producer and distributor, data regarding the wide and varied uses of cotton are rather meager. This outline of current uses of cotton, our most important fiber, is an important addition to the knowledge of the subject that is little known but one on which more light is necessary if the cotton industry is to cope successfully with present conditions.

Monthly Summary of Foreign Commerce of the United States. Part I, price, 10 cents. Part II, price, 5 cents. Subscription, $1.25 a year.

Monthly detailed statistical statement of the foreign trade of the United States.

Flour Markets of South America. Trade Information Bulletin No. 570. Price, 10 cents.

From the point of view of markets for flour the countries of South America may be grouped into those producing a surplus of wheat (Argentina, Chile, and Uruguay) and those which are largely dependent upon foreign sources for their supply. These latter countries purchase yearly some three million barrels of foreign flour, fully one-half of which is the product of American mills.

International Sole Leather Trade and Production in 1927. Trade Information Bulletin No. 571. Price, 10 cents.

Most of the leading sole-leather producers have found it exceedingly difficult to maintain their foreign sales during recent years, owing to the great increase in the production of this leather. Reliable estimates place the total world's production of sole leather in 1913 at only 780,000,000 pounds and in 1927 at 1,205,500,000 pounds, an increase of more than 65 per cent. This increased output has caused marked changes in the trend of the international sole-leather trade, as many countries formerly importing considerable quantities are now exporting. The United States, the United Kingdom, Germany, and France, in the order named, are the largest manufacturers of sole leather, producing more than 50 per cent of the total in 1927.

AERONAUTICS BRANCH

From a geographic point of view the bulletin containing "Airports and Landing Fields in the United States" may be of interest.

BUREAU OF MINES

Mineral Resources of the United States in 1927. (Preliminary Summary.) Price, 20 cents.

A summary statistical tabulation of mineral production and exports for the United States.

BUREAU OF THE CENSUS

Biennial Census of Manufactures, 1925. Price, $2.00.

The third biennial census of manufactures presents in detail industrial operations in the United States during the calendar year 1925. Prior to 1899 censuses of manufacturing industries were taken decennially and from 1899 to 1919 quinquennially, but the act providing for the fourteenth decennial census authorizes the collection and publication for the years 1921, 1923, 1925, and 1927, and for every tenth year after each of these years, of statistics of products of manufacturing industries.

Cotton Production in the United States. Crop of 1927. Price, 10 cents.

This report makes available immediately the statistics of cotton production, but they will also be included in the Annual Cotton Report.

U. S. COAST AND GEODETIC SURVEY

Supplements have been issued to the Coast Pilots for West Indies, Atlantic Coast (Sandy Hook to Cape Henry), Atlantic Coast (St. Croix River to Cape Cod), and Alaska.

Tides and Currents in Boston Harbour. Special Publication No. 142. Price, 30 cents.

This bulletin makes available the tidal and current data now in the files of the U. S. Coast and Geodetic Survey for Boston Harbour. Its very complete text is illustrated by many maps.

Elements of Map Projection with Applications to Map and Chart Construction. Special Publication No. 68. Price, 50 cents.

In this publication which is in two parts it has been the aim of the authors, Deetz and Adams, to present in simple form some of the ideas that lie at the foundation of the subject of map projections. The first part treats the theoretical side in a form that is as simple as the authors could make it; the second part attacks the subject of practical construction of some of the most important projections, the aim of the authors being to give such detailed directions as are necessary to present the matter in a clear and simple manner.

Tide Tables of the Pacific Coast—North America, Eastern Asia and Island Groups—1929. Price, 15 cents.

Current Tables, Pacific Coast—North America and Philippine Islands—1929. Price, 10 cents.

Tidal Bench Marks. State of California. Special Publication No. 141. Price, 15 cents.

RADIO DIVISION

Radio Service Bulletin, issued monthly.

BUREAU OF FISHERIES

Fisheries Service Bulletin, May 1, 1928, No. 156.
Fisheries Service Bulletin, June 1, 1928, No. 157.
Propagation and Distribution of Food Fishes, Fiscal Year 1927. Document No. 1033. Price, 10 cents.
Statistics of the Catch of Cod off the East Coast of North America to 1926. Document No. 1034. Price, 5 cents.
Trade in Fresh and Frozen Package Fish Products Economic Circular No. 63.
General Index to Fishes of Chesapeake Bay. Bureau of Fisheries Document No. 1024.

THE PANAMA CANAL

Panama Canal Record, Volume XXI, No. 44, June 6, 1928.

Attention is called to the "Monthly List of Publications" issued by the Department of Commerce and the U. S. Geological Survey. Anyone may receive these regularly by addressing the respective Departments.

HELEN M. STRONG.

Handbuch der E. von Seydlitzschen Geographie, Hundertjahrausgabe. Vol. I, Deutschland; Vol. III, Aussereuropäische Erdteile. By numerous collaborators. Edited by K. Krause and R. Reinhard. Ferdinand Hirt, Breslau, 1927. Vol. I, 408 pp.; Vol. III, 766 pp.

The authors, editors, and publishers of these volumes are to be congratulated for the splendid team work which has produced a work highly commendable for form and contents alike. That which strikes the eye of the reviewer first is the unusually attractive appearance of these volumes. From a book-making standpoint, they are well-nigh perfect. They are bound in high-grade unstarched cloth of a singularly beautiful shade of blue with the inscription deeply stamped in artistically designed gold lettering. Each volume is illustrated with a number of full-page half-tone views, with literally hundreds of photographs and additional hundreds of well executed graphs, diagrams, statistical tables, etc. In order to assure the best possible results, the photographs are printed on enameled paper and for that reason they are arranged in groups of eighty to one hundred following each major geographical region.

When completed the work will consist of four volumes, the first of which deals with Germany, the second with Europe outside of Germany, the third with the world outside of Europe and the fourth with "General Geography of Nature and Man." So far only Volumes I and III have come into the reviewer's hands.

These four volumes represent the centenary edition of a geography which Ernst von Seydlitz Kurzbach, at that time a superintendent of schools in Silesia, published in 1824. The first edition covered only 240 small pages of text and was practically devoid of all illustrative material of any sort. The centenary edition in its four volumes will cover all in all probably not less than 2,400 pages; in other words, exactly ten times as many as the first edition. The contrast is accentuated by the overwhelming wealth of illustrative material which the present edition contains.

We would fail to do justice to this magnificent achievement were we to confine our remarks to mere size and external qualities. For, also, in regard to the quality of the contents, this centenary edition represents an advance not only over the early "large or small Seydlitz geographies," but even over the more recent editions. No effort has been spared to keep the contents abreast of the times, not merely in the mechanical sense of keeping statistics up-to-date, but also in the organic sense of giving to each edition the fullest benefit of every advance in geographical theory and every extension of human knowledge in the field of anthropology, geography in all its aspects, and of political science in so far as it affects geographical knowledge or is in turn affected by geographical conditions.

In this centenary edition great emphasis has been placed upon causal relationships between geographical, economic, and political conditions and upon geographical interactions. Through this treatment of the descriptive material the value of this geography to a wide circle of readers has been greatly enhanced.

For post-war Germany to undertake such a task seems ambitious to say the least. To produce an up-to-date world geography requires not only the collection of statistical and descriptive material from the four corners of the world, but also the collection of first-hand information through traveling representatives. Such an enterprise requires funds which one would hardly hope to find in a country impoverished by years of warfare.

Possibly a certain economy was necessitated by these conditions and perhaps this economy has left its influence, at least, on certain sections of the otherwise excellent work. Naturally we turn to the chapters on the United States to determine how up-to-date is the material on distant (from the German standpoint) regions. We find here that such recent publications as Whitbeck and Finch, J. Russell Smith's North America, Jones and Bryan, etc., have been used. Generally speaking, therefore, the information is decidedly up-to-date. On the other hand, the discussion of the individual states given on pages 471 following would seem to leave considerable room for improvement. Thus in the discussion of the twelve southern states not a word is said about North Carolina, an omission which probably strikes the reviewer as more serious than it might many others. Yet it seems that even a brief account of

the South should bring out definitely and clearly the remarkable industrial transformation that has been going on for several decades, the center of which is North Carolina. It will hardly do to explain the successful competition which southern cotton mills are giving the New England industry solely by reference to the proximity to raw material. Yet this is the explanation which we frequently find even in American sources and we might, therefore, be lenient with those who, on account of their remoteness, lack the opportunity of studying the situation at first hand. One can hardly tell the story of Michigan and Ohio without mentioning the automobile, or of Akron without mentioning the automobile tire. The description of Cleveland as lying at the northern end of the Ohio Canal seems to imply that the German geographer has falsely transferred his idea of the economic importance of inland water transportation from his own country to this. Off hand, one would doubt the statement that Cleveland refines more petroleum than any other city in the world. Nothing is said of the important coal production of Ohio, Indiana, Kentucky, and Illinois. The statement, that the wheat and ore boats on the Great Lakes carry coal as return cargo, seems too general. In view of the division of the lake fleet into independent carriers and ships owned by steel companies and other industrial concerns, and in view of the somewhat peculiar policy of the United States Steel Corporation, this sentence would require considerable qualifications. Perhaps it is an impossibility to give a satisfactory account of the economic conditions of the forty-eight states on the scanty space of sixteen pages. To describe three states on a page requires an ability to discriminate between the most important and the slightly less important which only the greatest expert may be expected to possess.

This brings us to a suggestion which might help to render future editions more accurate in detail and, therefore, more valuable to the reader. This suggestion is to have sections of the manuscript dealing with different large economic areas, such as the United States, submitted to a recognized authority in that territory. This authority should be responsible for the details of that particular portion of the manuscript. The reviewer feels that in that way only such regrettable errors as enumerating Mr. Sears and Mr. Roebuck among the captains of industry of the United States—this particular error marred an otherwise excellent article which recently appeared in a first-class economic journey of Germany—are sure to be avoided.

It is only with the utmost reluctance that one criticizes a work of such beauty and painstaking industry. Yet, if adverse criticism is offered in a spirit of coöperation it is apt to be received in a like spirit. Those who have accomplished this worthy piece of work can well afford to have the slight flaws which here and there mar its pages pointed out to them.

This geography should be in the hands of all those American geographers who can read German and beyond that group it is apt to find favor with additional circles of the book-loving public who can at least enjoy its beauty.

ERICH W. ZIMMERMANN.

JOHNSON, MARTIN. *Safari: A Saga of the African Blue.* x and 294 pp., illus. and map. G. P. Putnam's Sons, New York, 1928.

In fifteen chapters of the most fascinating and readable narrative imaginable, Martin Johnson in this interesting book *Safari* succeeds in making west central Africa a land of picturesque reality, and in painting, as no one else has done, a vivid picture of a faunally rich section of this old world of ours while yet the "age of mammals" has not wholly passed away.

Africa, the so-called "Dark Continent," has ever been a land of lure and mystery, where man-population has ever been sparse and large animal-population has long been dense. The great areas of savanna and grassland about the equatorial forest afford conditions favorable for the development and existence of an exceedingly rich mammal fauna, generally of large forms, both herbivore and carnivore, but unfavorable for the rise of a great human group to prey upon them. The age of mammals apparently reached its highest development in point of numbers and variety on these great grasslands, savannas, and semi-deserts of Africa. Here the many kinds of antelope, zebra, giraffe, buffalo, rhinoceros, elephant, lions, leopards, hyenas, and a hundred others have persisted in tens and hundreds of thousands far into the age of man, and though some forms have been totally exterminated in the last century and others have been reduced to a mere handful, many still haunt the more remote and inaccessible places.

It was into one of these unfrequented places that Martin Johnson, and his good wife Osa, were fortunate enough to be led by Carl Akely, the greatest and most sympathetic naturalist who ever explored Africa's lonely grasslands, while still the rich animal life was relatively undisturbed and unchanged by the ravages of the white man's rifle, as deadly to the mammals as the tsetse-fly has been to man; and in Kenya, just south of the Ethiopian border, along the western edge of the Kaisoot desert, they came upon the primeval haunts of a pristine African fauna. There on the shores of a lovely little pool, which they aptly named Lake Paradise, they set up their *lares* and *penates*, made headquarters for their expeditions, and sketched by notebook and pencil, and recorded by plate and film, the wonderful animal life that surrounded them.

The photographs are remarkable. They preserve for all time, to all posterity, a glimpse of that rich mammal life for which much of the world has been noted in the "age of mammals" now well-nigh past, surviving only in such restricted

and concealed localities as the environs of Lake Paradise.

Martin and Osa Johnson have lately returned to Africa, accompanied by three sturdy American Boy Scouts, the pick of this whole glorious organization. What stories they will have to tell when they return, what adventures to relate and to treasure, what geographers they will be!

W. ELMER EKBLAW.

Europäische Zollunion. By numerous collaborators. Edited by Dr. Hanns Heiman. 278 pp. Reimar Hobbing, Berlin, 1926.

This book is a symposium. It contains twenty-two articles on various phases of the problem of the European customs union, written by well-known economists, government officials, and political leaders.

It is hardly necessary to take the time to explain why a book which deals with the problem of turning Europe, America's sole industrial competitor, into a free trade area is of the greatest interest to the economic geographer. Geography affects institutions and, vice versa, institutional changes weaken or strengthen geographical influences. The successful establishment of a European customs union would undoubtedly be one of the most far-reaching institutional changes which the twentieth century could accomplish on this planet.

The book is meant to serve no other purpose than to inquire and to enlighten. At least that is the avowed aim of the editor. Yet he hopes that such inquiry and enlightenment will promote rather than hinder the cause of the economic rapprochement of Europe. One feels that even those contributors who do not favor the establishment of a European customs union as the most feasible method of improving economic and political conditions on that continent, are trying their best to place the most favorable interpretation possible on the facts and causes which they examine. Throughout the pages of the book one feels that Europe is weary of war, one feels an increasing discontent with the insane tendency toward neo-mercantilist policies, and one feels that the anachronism of such policies in the day of "rationalization" is being fully realized.

The slogan of the book might be called the restoration of Europe to its former place in world economy. Yet the practical ideas which various authors contribute to this major aim are strangely different. Thus Kalckreuth, the veteran junker parliamentarian, with his eastward orientation, stands well-nigh at the opposite end of the line from Dr. Gothein, who favors a closer coöperation with the countries of Western Europe. Other contrasts are equally noticeable. Thus there seems to be wide divergence of opinion regarding the point whether economic pacification should precede or follow political rapprochement. In that respect we find Schnee (the well-known colonial authority), Goehre, and Gothein on one side and von Koerner, Friedensburg, and Riedl on the other. The conflict is strongest probably in the writings of Stolper and Eulenburg.

In appraising the importance of this discussion, it is well to realize that out of the twenty-six European states which existed before the war thirty-five have been created; that instead of twenty-six customs areas there now are thirty-eight; that instead of thirteen currency systems there now are twenty-seven. There can be little doubt that anything which simplifies this almost chaotic condition will prove helpful, but whether a customs union which touches upon national sovereignty is the most logical way to bring about this increased simplicity seems greatly questionable to many of the contributors. Some of them also believe that the argument of the enlarged marketing area—the idea that the increase of the market tends to reduce the cost of production of manufacturing industries—has been greatly overdone. It is claimed that many other factors beside the extent of the market enter the equation.

For the geographer undoubtedly the most attractive contribution is that by Professor Alfred Weber, the well-known authority on the location of industry, an English version of whose standard work on the subject is soon to be published by the University of Chicago Press and whose theories have repeatedly been commented on in the columns of the *Journal of Political Economy*. His contribution carries the title, "Europe as a Center of World Industry and the Idea of a European Customs Union." This is a masterful analysis of the forces which are apt to control the major shifts in the world distribution of manufacturing industry. With keen perception of reality, Weber dispels the mists of European pessimism which rise from bemuddled feelings rather than from objective analysis of the facts. It would lead too far fully to explain the ingenious ways through which Weber arrives at his conclusions. It is the reviewer's opinion that a translation of this article would make a splendid contribution in the columns of this journal.

Altogether the book is decidedly worth while. It is doubtful whether the fairness with which the editor has given untrammeled opportunity of expression to friend and foe alike has promoted the cause of the European customs union, but there can be little doubt that this fairness has led to the creation of a volume which possesses great interest and value to all serious students of economic geography.

ERICH W. ZIMMERMANN.

BYRD, COMMANDER RICHARD E. *Skyward.* xv and 359 pp., illus. G. P. Putnam's Sons, New York, 1928.

Ten, or twenty, or mayhap a hundred, years hence the economic geographer working over transportation problems will look to *Skyward* and similar early works on aviation for the authoritative source material that he seeks. No discussion of the initial development of this latest, and

most wonderful, of man's achievements of increased mobility, this most expeditious of means of transport, will be complete without reference to *Skyward*. Not so much by direct, categorical statement, as by picturesque example and suggestive inference, does Commander Byrd succeed in portraying the first experiences, the first technique, the first equipment in flying, but the picture is none the less clear and convincing.

Man's mobility exceeds that of all other living things. His "oikumene" has been extended to the uttermost corners of the earth. By his own strong legs, by canoe or ship, by dogsledge or cameltrain he has penetrated to almost every mountain niche and jungle valley. Now he has turned "skyward" and above the clouds he seeks "new worlds to conquer," mobile over land or sea with an ease and despatch that the eagles and the frigate-birds might envy.

How interesting it would be if we might have accounts similar to *Skyward* of early water navigation! How fascinating it would be to read the epic of the voyage of the first Chinese junk, or of the first Egyptian dhow, or of the first Eskimo kayak, a saga of the first Viking ship or the first Phoenician trader! Commander Byrd merely hints at some of the early difficulties of water navigation in contrast with air navigation, as follows: "We have been over the same hurdles with craft that travel on the sea. Early boats of the Nile dwellers were flat-bottomed. They had no keel or bilges. They drifted about at the mercy of every breath of air unless the oarsman was continually on the job. Now we have automatic stability in our ships that is gained in several ways. Bilge keels steady them when rolling and yawing. A large deep rudder aft prevents sudden swinging. A heavy keel, or keels, governs their leeway to a large degree. The helmsman has but to touch his wheel or lever occasionally to keep the huge *Leviathan* on her course."

Skyward despite its practical value as a reference on aviation is a stirring narrative, into which Commander Byrd has crowded so much rich incident, picturesque description and thrilling adventure that no one whose blood pulses red and warm with the glow of excitement over deeds well done and dangers dared and conquered, can put the book down until he has finished it, once he has read the first chapter. Like Lindbergh's *We*, it is a "thriller!"

The book is all the more significant in view of the latest expedition upon which Commander Byrd is now venturing, the exploration of Antarctica by air. This great ice-covered continent, almost unexplored, the biggest blank space left on the map, must now yield up its secrets to the indomitable leader, who with his companions will turn upward and skyward for its conquest when they come to its stern barriers, hitherto well-nigh impassable.

In cordially approving *Skyward* one must give due credit to Putnam's and the Knickerbocker Press for the excellent job of bookmaking that it represents. Like *Safari* and *We* and a score of other similar books, it makes one wonder "how they can do it at the price."

W. ELMER EKBLAW.

BOOK NOTICES

VAN CLEEF, EUGENE. *Foreign Trade Activities in Ohio.* A special bulletin of the Bureau of Business Research, College of Commerce and Administration, The Ohio State University, 1928.

An interesting and valuable study, critically made, by a foreign trade expert. It is not so much the significance of the results as it is the technique of investigation that makes this paper so valuable. A few well-chosen items of bibliography close the study.

Weltwirtschaftliches Archiv. Zeitschrift des Instituts für Weltwirtschaft und Seeverkehr an der Universität Kiel. Vol. 28, No. 1. Gustav Fischer, Jena, July, 1928.

Another number of this really indispensable serial, with over 550 pages of data and valuable descriptive and explanatory material relating to the many phases of economic geography. The excellent reviews of current literature, the comprehensive bibliographies, and the illuminative articles, composing the numbers of this publication, render it a most significant reference.

JONASSON, OLAF. *Europas och Nordamerikas Jordburksregioner.* (The Agricultural Regions of Europe and North America.) A reprint from *Ymer*, the Journal of the Swedish Anthropological and Geographical Society, 1923, No. 3.

A brief but most suggestive summary of the controlling factors in the distribution of agricultural type activities and landscapes and a comparison of the agricultural regions of Europe and North America. A valuable article, unavailable to most English-speaking peoples because it is written in Swedish, but the author's "Agricultural Regions of Europe" in ECONOMIC GEOGRAPHY, Vol. 1, No. 3 and Vol. 2, No. 1, presents a great deal of the same material.

ANDERSSON, GUNNAR. *Sweden's Natural Resources in Relation to Industry.* Reprinted from "Industry in Sweden," Upsala, 1927. The press of Almquist & Wiksell.

In this excellent little bit of economic geography, the veteran geographer reveals himself at his best, his judgment and critical ability unimpaired by the burden of years he bears. It is one of the most compact, though inclusive, discussions of the subject that has appeared, and should be in the files of every student and teacher of European geography.

ANDERSSON, GUNNAR. *Den Svenska Industriens Geography* (The Geography of Sweden's Industry). Reprinted from *Ymer*, the Journal of the Swedish Anthropological and Geographical Society, 1926, Nos. 3 and 4.

Though in Swedish, this excellent presentation of the geographic relations of Sweden's industries to the milieu merits a place in every American geographer's bookshelves. It is valuable not only for the rich factual material it summarizes, but because it suggests points of approach and methods of development that open up a number of new fields for the economic geographer.

SMITH, J. RUSSELL. *Human Geography*. Book I, Peoples and Countries; Book II, Regions and Trade. John C. Winston Company, Philadelphia, 1926.

Books for children that are incomparably interesting the while they teach the essential and vital facts of geography in its best and most useful phases. Superb text books, they lure even the unwilling child to a desire for study; they delight the eager pupil; they appeal to the critical teacher; they satisfy the parents who wish their children to learn. J. Russell Smith knows what geography is, what children like, and how to make children not like, but *love*, geography.

BENNETT, HUGH H., and ALLISON, ROBERT V. *The Soils of Cuba*. Tropical Research Foundation, Washington, D. C., 1928. $6.25.

This truly remarkable and highly specialized treatise includes a "generalized soil map and detailed descriptions of the physical and chemical qualities of the more important soil types, together with notes upon their general cultural requirements in relation to their agricultural adaptability and usefulness, with a chapter on soil classification by Dr. Curtis F. Marbut." The main body of the book constitutes a most valuable basic reference and source for knowledge of Cuban geography. The chapters on the Isle of Pines, the climate, and the relation of soils to agriculture are a valuable addition, and Doctor Marbut's chapter on soil classification is a gem.

EMERSON, FREDERICK V. (Revised by John E. Smith.) *Agricultural Geology*. xvi and 363 pp., illus., charts, and maps. John Wiley & Sons, 1928.

The title is a misnomer; it should be "Geology for Agricultural Students." As such it is an excellent book, easily read and probably is easily taught and understood. It should prove a popular text, now as always.

BENNETT, MERRILL K. *Farm Cost Studies in the United States*. Miscellaneous Publications No. 4, June, 1928, of the Food Research Institute. xv and 289 pp.

An exhaustive analysis of farm cost data and the methods of collecting, interpreting, and using them, of such value to the economic geographer as to be indispensable. Excellent bibliographic notes accompany every one of the twelve chapters. While the conclusions, it is stated, are largely destructive they clear the way for a new system of study, based on more rational premises and more practical methods.

MEAD, EDWARD SHERWOOD, and OSTROLENK, BERNHARD. *Harvey Baum, A Study of the Agricultural Revolution*. 148 pp. University of Pennsylvania Press.

Apparently a provincial and rather pessimistic argument for the development of a European type of agriculturist in order to develop a superior type of urban population. It would seem that the more optimistic solution of the problem would be the coördinate development of a high-class agricultural population and an equally high-grade industrial population. America is the one land where an adequate reserve of iron and coal and other essential requisites for industry insure its continuance, and a physical environment surpassingly favorable to the production of food, textiles, lumber, and the other essentials of life by agriculture, are contained within the borders of one nation or one region. Northwest Europe with its coal and iron lacks food; Eastern Asia with its teeming populations lacks iron and coal. Eastern North America alone has iron and coal and people and adequate food for them. Rather than the exploitation of either the agricultural or the industrial group by the other, should not the two make reciprocal sacrifices, that both may prosper exceedingly?

CLINE, ISAAC MONROE. *Floods in the Lower Mississippi Valley*. 28 pp. Published by New Orleans Board of Trade, 1927.

A concise account of flood history and flood conditions from Memphis southward. A valuable reference.

PHILIP, GEORGE, and MCCONNELL, W. R. *Modern School Atlas*. D. Appleton & Company.

Little distinctive to recommend. A fairly good general school atlas. Obviously made and priced to sell.

VOLZ, EMIL C. *Home Flower-growing*. xxii and 342 pp., many illustrations. The Macmillan Company, New York, 1928.

Of great value to the horticulturist, the home gardener, and the flower lover it has merely incidental personal, not professional, significance to the economic geographer.

ROCKWELL, F. F. *Rock Gardens*. 86 pp. The Macmillan Company, New York, 1928.

A practical, compact little compendium on the subject, written not solely for the economic geographer, but for him as the average citizen. A worth-while little book for the home, inexpensive and full of worth and suggestions.

W. ELMER EKBLAW.

ANNOUNCEMENT

THE series of articles, *Agricultural Regions of the World*, is continued in this issue with the sixth instalment of *Agricultural Regions of North America*, by Dr. O. E. Baker of the United States Bureau of Agricultural Economics, presenting the latest and most authentic data available on North American agriculture. The next instalment of *Agricultural Regions of North America* will appear in the January issue.

Dr. Clarence F. Jones is now in South America assembling authoritative data, and studying conditions in the field, for the completion of his series on the *Agricultural Regions of South America*. Upon his return his series will be resumed.

Agricultural Regions of Africa, by Homer L. Shantz of the University of Illinois and president-elect of the University of Arizona; *of Australia*, by Griffith Taylor of the University of Sidney, one of the foremost geographers of the world; and *of Asia*, by Olof Jonasson of the University of Commerce of Stockholm will follow in later issues to complete the finest geographic discussion of the world's agriculture thus far published.

To obtain the complete series of these extremely valuable articles, which present for the first time on such a comprehensive and accurate basis the significant divisions of the world's most important industry, it will be necessary to subscribe at once for ECONOMIC GEOGRAPHY, and date back to the October, 1926, issue.

In addition to this series of articles on agriculture, other series are being initiated; every issue will also contain four or five other articles dealing with urban and regional geography, with problems of land utilization, with programs of development of resources, with commerce, with transportation, with health, and with the hundred and one other subjects that are of present geographic interest, all by the most competent and best informed authorities in their respective fields. ECONOMIC GEOGRAPHY is indispensable to the intelligent citizen.

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ELLEN CHURCHILL SEMPLE.

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